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CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICE—
Fourth Annual Meeting, Pacific Coast Gas Association..... 997

EDITORIALS—
Briefly Told 997
Municipal Ownership, etc., as Discussed at the Meeting of the Texas Gas and Electric Light Association—Notes.
Acetylene for Lighting Tram Cars..... 998
Coal Gas Enrichment, by Mr. A. F. Browne 998
Determination of the Calorific Value of Coals, by Mr. E. Goutal...1000
A Suggested Remedy for a Source of Error in Official Photometry, by Mr. Lewis T. Wright.....1001
Notes on Residuals, by Mr. Chas. Hunt.....1002
Single Phase Self-Starting Synchronous Motors, by Mr. F. H. Leonard, Jr. 1004
Something about Packing, by Mr. W. H. Wakeman.....1005
The Making of a Boiler, by Mr. Fred De Land.....1007
*The Cripps Improvement in Purifier Construction.....1008

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.....1009
Consolidating the Plant of the Brooklyn Union Company—Hints from New Bedford, Mass.—An Interesting Letter—The Proposed Opposition for Los Angeles, Cal.—Sale of the Fishkill (N.Y.) Works—Contract for the Berlin Iron Bridge Company—Annual Meeting, New Brunswick, N.J.—To Exchange the Washington (D.C.) Company's Certificates for Stock—Office Building for the Lynn (Mass.) Company—Annual Meeting, Exeter, N.H.—The Spring City Company Assigns—Public Lighting, San Antonio, Texas—The Agreement between the San Francisco Gas and Edison Companies—Resignation of Major Symington—The Pawtucket (R.I.) Company Challenges the Authorities—Hints from Little Falls, N.Y.—Annual Meeting, Port Hope, Ont.—And Other Items.
Lighting Jute Mills in India.....1011
The Market for Gas Securities.....1011

[OFFICIAL NOTICE.]

Fourth Annual Meeting, Pacific Coast Gas Association.

OFFICE OF THE SECRETARY, OAKLAND, CAL., June 10, 1896.

The fourth annual meeting of the Pacific Coast Gas Association will be held at the office of the San Francisco Gas Light Company, corner of First and Natoma streets, San Francisco, Cal., July 21st and 22d, 1896. The headquarters will be in Parlor "C," Palace Hotel. The Secretary will be in attendance at headquarters from 10 A.M., Monday, July 20th. The sessions will be convened at 10.30 A.M. and 2 P.M. The following papers will be read:

"The Economy of Coals," by Mr. John L. Howard, San Francisco, Cal.

"The Relative Position of Consolidated Gas and Electric Light Plants," by Mr. M. C. Osborn, Santa Cruz, Cal.

"Oil Tar and its Uses," by Mr. J. B. Grimwood, San Francisco, Cal.

"Telescoping a Single Lift Holder while in Use," by Mr. J. L. Fogg, San Francisco, Cal.

"Gas Stoves," by Mr. D. Decker, Fresno, Cal.

"Municipal Ownership," by Mr. John A. Britton, Oakland, Cal.

"Evolution of a Gas Meter," by Mr. Chas. H. Dickey, Baltimore, Md.

"Wrinkles," edited by Mr. T. R. Parker, Napa, Cal.

"Experiences," edited by Mr. John Clement, Red Bluff, Cal.

"Question Box."

In addition to the papers mentioned, there will be an exhibition of acetylene gas and of the Roentgen rays during the progress of the meeting.

A meeting of the Board of Directors will be held at headquarters, Monday, July 20th, at 8 P.M. The annual banquet will be held in the Palace Hotel, at 8 P.M., of Wednesday, July 22d. Thursday, July 23d, will be devoted to the social part of the meeting, which is to consist of an excursion over the electric scenic road now being built to the summit of Mount Tamalpais. The Question Box is now ready for such questions as members may choose to propound.

JOHN A. BRITTON, Secretary.

BRIEFLY TOLD.

MUNICIPAL OWNERSHIP, ETC., AS DISCUSSED AT THE MEETING OF THE TEXAS GAS AND ELECTRIC LIGHT ASSOCIATION.—Those engaged in the supply of artificial light from central stations in the State of Texas may well be pleased over the papers presented at the second annual meeting of the Texas Gas and Electric Light Association, and additional satisfaction should be their portion from the fact that the discussion on the papers was about as good as the papers—and neither the papers nor the discussions thereon require, for valuation, comment at our hands. Texas may differ from New York in the matter of attempting to fix the ultimate values of the silver and of the gold ounce, but there's small variance between Texas and New York when it comes to gas men to fix the relative value of gas, in Fort Worth or San Antonio, in New York or Brooklyn. The gas standard is unalterably adjusted to a basis of fair trading that stood, and stands to-day, a model far be-

yond the standard of any other important industry of the world. The authorities of any place in which gas is sold may deny that the product of the company supplying them is up to standard, but a resort to the practical tests, for the determining whether the authorities are right or the company is wrong, is at the immediate command of either, and so the dispute is easily ended—the results of the peregrinations of the unauthorized gas meter inspectors is submitted here as proof of the fact that gas meters are more liable to play the gas company than the gas consumer false. Certainly we need not be in any sense the "explainers" of the gas meter, so far as its accuracy is concerned; for the inspection of its simple operation could not fail, through a looking over its mechanical construction, to show a man, even of the most "indomitable will," that it could do no other than tell the truth, if it were maintained in a location where its normal work should be done. Of course, we will have to admit that so far our comment has had little to do with the question of "Municipal Ownership," as discussed at the May meeting of the Texas Association, but a reference to the records of that meeting may show that meters and municipal control have much in common. Certainly, there are gas meters, and there may be others. So far as the suppliers of light from central stations are concerned, there seems to be only one meter in the field—the gas meter. Such is the burden of the air and frank discussion that was had at the Texas meeting, and such is the unspoken verdict of the users of artificial light in New York City. This admission brings us to a consideration of our subject proper, which was to have treated of municipal ownership, but which has narrowed to a consideration of whether Mr. T. D. Miller, in his paper on the "Fixed and Variable Expenses in Manufacturing Plants," is very much apart from the paper by Mr. W. E. Holmes," on "Municipal Ownership," or very greatly removed from Mr. Monroe's paper on the "Use of Meters." Perhaps we might say that Mr. Miller, in his paper, built the works, that Mr. Holmes laid the pipes, and that Mr. Monroe attended to the collections; but, in any event, the three combined show that fairness must lead and follow in the supply of artificial light, from central stations, whether such supply be controlled by private enterprise or public assessment, if the people are to be adequately served. And we further submit that the Texas Association papers and discussions are all in favor of the gas meter, as against the electric meter, no matter whether the artificial lighting supply of any place is in the hands of the authorities or is controlled by private enterprise. In the meantime it is worthy of note and remembrance that the Texas lighting men had the courage to say openly and above-aboard that which they did say when the three papers named were being discussed.

NOTES.—The Board of Contract and Apportionment, Albany, N.Y., has accepted and ratified the proposition of the Municipal Gas Company, of Albany, for the lighting of that city, for the period of 5 years, dating from June 21st, by means of electric arcs. The accepted rates were: For furnishing and placing each lamp, $30; lighting each lamp, per night, 34 cents; furnishing each globe, 30 cents; repairing and cleaning lamps, $5; charging lamps from selected location, $5 each; new iron lamp post, with bracket, $40; iron-wire-supporting pole, $25; new bracket or mast-arm lamp post, $20; new wire-supporting pole of the sort now in use, $2.25. The sureties were Mr. A. N. Brady and Mr. R. C. Pruyn. Take it by and large, the contract looks to be a good one for the Company.——The consolidation of the gas and electric lighting interests of Bristol and Warren, R.I., has been accomplished on an equitable basis.——The Municipal Electric Light and Power Company, of Decatur, Ills., may have to fight for its life through the ministrations of a receiver.——The Peoples Gas Company, of Chicago, has placed canvassers in the territory west of California street in that city, with a view to extending the use of gas for cooking. As an incentive the Company offers to make stove connections free of charge, until August 1st.

Acetylene for Lighting Tram Cars.

The British *Journal of Photography* says that acetylene is being tried in some of the tram cars in Paris, and with promising success. The generator, containing the calcium carbide and water, weighs under 30 lbs., and is placed beneath the steps of the vehicle, and it contains sufficient material for generating 35 feet of gas. As the lighting power of acetylene gas is something like fifteen times that of coal gas, the cost is stated to be less than that of illuminating the cars by petroleum. Doubtless, after this, we shall have a practical and safe application of acetylene for lantern purposes next season.

Coal Gas Enrichment.

[A paper read by MR. A. F. BROWNE before the Incorporated Institution of Gas Engineers.]

It is proposed to deal in this paper with four of the available methods of enrichment under the following heads: Controllability; Cost into Gasholder; Permanency; Illuminating Power and Enrichment Effect.

Neglecting that most interesting method of enrichment by destructive distillation of the tar oils known as the "modified Dinsmore process," which, while presenting itself to the mind as the natural source of coal gas enrichment, and, if practicable, inevitably the cheapest, has not yet secured general recognition, there remain the following:

Cannel gas Carbureted water gas Oil gas	Products of destructive distillation of coal or oil at temperatures above a red heat.
Evaporable hydrocarbons	Products of fractional distillation of petroleum and coal tar at low temperatures.

These may be classified as above in the following order:

(1) Controllability.	(2) Cost into Holder.	(3) Permanency.	(4) Illuminating Power and Enrichment Effect.
Evaporable hydrocarbons.	Water gas.	Cannel gas.	Hydrocarbon vapors.
Oil gas.	Oil gas.	Oil gas.	Oil gas.
Water gas.	Hydrocarbon vapors.	Water gas.	Cannel gas.
Cannel gas.	Cannel gas.	Hydrocarbon vapors.	Water gas.

I.—READY CONTROL.

Evaporable Hydrocarbons.—The evaporative system is now so well known as to need no description. Everyone will agree that a method which can be brought into full operation at a few minutes' notice, and of which the effect can be varied at will, can scarcely, from this point of view, be improved upon; and no gas maker who has once experienced its advantages will ever part with so speedy and (within the limit of the vapor tension of the liquid dealt with) so reliable a method of enrichment.

Oil Gas.—Mr. S. Glover, in his paper upon "Enrichment of Coal Gas by the Peebles Oil Gas Process," read before this Institution in 1894, says: "The oil gas, being made quickly and easily, gives a ready means of controlling the illuminating power."

Carbureted Water Gas.—The writer is privileged to quote the experience of two engineers possessing most extensive water gas plants situate in London, as follows:—

(1) "The ease with which we can alter the quality of the carbureted water gas is a most convenient factor. I am enabled to maintain a constant quality of supply throughout the whole 24 hours."

(2) "With regard to altering or adjusting the illuminating power as we vary the proportion of the two gases, so as to keep our output regular, I can say very emphatically that it is the most simple matter one could possibly desire. The difference in the outgoing gas can be adjusted with almost microscopic exactness. Beyond the facility, there is the still greater advantage of positiveness. The record of the illuminating power is characterized by its monotonous regularity."

II.—COST INTO GASHOLDER.

The comparative cost per 1,000 cubic feet of these enrichers into the holder in London, as compared with that of common gas (say 25 cents), is as follows:—

(1) Carbureted Water Gas.	(2) Peebles Oil Gas.	(3) Carburine Vapor.	(4) Cannel Gas.
Enrichment Effect. 21 candles.	90 candles.	300 candles.	35 candles.
Cost. 27 cents. Mean of two London installations.	93 cents.	$6.50	66 cents.
35½ cents. At enhanced price of oil.	$1.18 At enhanced price of oil.	——	——

And to raise common gas from 15 to 17 candles, the following mixtures must be made:—

	(1) Per Cent.	(2) Per Cent.	(3) Per Cent.	(4) Per Cent.
Common gas.	15 c., 66.66	15 c., 97.30	15 c., 99.300	15 c., 90
Enricher.....	21 c., 33.33	90 c., 2.66	300 c., 0.702	35 c., 10
	99.99	99.96	100.002	100

Additional Cost per 1,000 *Cubic Feet of Mixed Gases.*

	(1) Cents.	(2) Cents.	(3) Cents.	(4) Cents.
Mixed gases	25.00	25.760	28	28
Common gas	24.00	24.000	24	24
Per 2 candles	1.00	—	14	4
Per candle.....	0.50	0.880	2	2
Per candle at enhanced price of oil.....	1.90	1.092	—	—

III.—Permanency.

This word, so familiar to gas makers, is somewhat ambiguous. Perhaps, therefore, the writer may be pardoned for thinking it necessary to define it's meaning in this paper.

Gases and vapors must be considered to be merely relatively permanent and non-permanent. The difference between a gas and a vapor is a difference of degree, not of kind. A vapor is, to all intents and purposes, a gas, within, up to, and as far as its point of saturation ; the latter varying with the temperature and pressure to which the vapor is exposed. Nevertheless, it must be conceded that the vapors in coal gas are on a different footing to the gases.

There is a great gap between the richest permanent gases (so called) and the poorest vapors which are liquefiable at temperatures obtaining under natural conditions. For instance, in the methane series, pentane is a liquid below 100° F.; butane, below 34° F.; propane, below — 4 F. These are all present in small quantities in coal gas or coal tar: but ethane requires a pressure of 46 atmospheres to condense it at 39° F. In the ethylene series, amylene is a liquid below 102° F.; the next below it, at 34° F. But ethylene itself is gaseous above — 166° F. When we come to the heavy vapors of the benzene series, of which benzene itself is a liquid at 177° F., we may well be surprised that temperatures so far below 32° as were experienced in the winter of 1894–5 do not impoverish coal gas to a far greater extent than is actually found to be the case. This is due to three facts : The first that, as Professor Lewes has told us, saturation is not a question of density or boiling point, but of vapor tension ; the second, that there is a mixture of light and heavy vapors in coal gas which partially dissolve one another (establishing a joint or balanced vapor tension, and thus the heavier vapors are retained by the agency of the lighter); the third, that the vapors in common coal gas are unsaturated at temperatures below 32°. If it were not so, and if all vapors condensable to liquids at 32° were, in the pursuit of an ideal permanency, removed, as they might be, from coal gas, there would be comparatively little luminosity left.

The available enrichers may now be compared, from the standpoint of permanency, in the order of classification.

(A) *Cannel Gas.*—This gas differs from common gas more especially as regards the vapors which it carries. Mr. G. E. Davis, in a paper[1] read before the London Section of the Society of Chemical Industry on Feb. 2, 1886, showed that there are considerable differences between the vapors existing in cannel gas, as compared with those in common gas, with respect to the boiling points of the liquids from which the vapors are derived. From a sample of common gas of 17-candle power, he obtained 81.7 per cent. of liquids having boiling points below 235.4° F., and 1.2 per cent. below 176° F.; while from a sample of cannel gas of 27-candle power, he procured 95.3 per cent. of liquids having boiling points below 235.4° F., 29.9 per cent. below 176° F., and 12 per cent. below 73.4° F. The vapors of these latter liquids required condensation in ice and salt.

He drew the conclusion that cannel gas substantially differs from common gas in the much larger percentage of hydrocarbons contained, having lower boiling points and higher vapor tensions. It is this fact which, in the opinion of the writer, justifies his placing cannel gas at the head of the list of enrichers, from the point of view of permanency.

(B) *Oil Gas.*—The Peebles process, the invention of Messrs. William Young and Alexander Bell, has been placed second on the list for precisely similar reasons ; its extraordinary luminosity being due to the presence of a large quantity of the more volatile vapors. The writer avails himself of this opportunity to express his very sincere thanks to Mr. W. Young for detailed information, readily given, explanatory of this beautiful process. There can be no question that the system is based upon sound scientific principles, the application of which has been thoroughly considered and worked out by men fully qualified by special training to deal with the subject.

That the process is one of fractional decomposition of the oil is probably generally known ; but it may not be equally widely understood that the inventors, to ensure the permanency of the gas, have devised a most interesting method of fractional condensation by contact of the outflowing gas with the inflowing oil—a method which deserves the closest scrutiny of gas engineers, in order that they may learn how not to do it in the case of coal gas, and appreciate afresh the necessity of avoiding a similar absorption of vapors by the tar oils during condensation. Suffice it now to say that the final result is thus summed up by the inventors :—

"We discovered that the extremely rich gases produced at these low temperatures were so loaded with vapors that they required to be carefully fractionally condensed. The oil scrubber has for its object the fractional treatment of the gas and condensable products, so that the gas will pass away only containing the most volatile hydrocarbon vapors, and only these in such quantities as will remain permanently gaseous and be suitable to the purpose to which the gas has to be applied, whether used alone or for enrichment purposes."

(C) *Carbureted Water Gas.*—It may be considered that, as regards permanency, water gas should be ranked before oil gas and next to cannel. From the point of view of enrichment, carbureted water gas is certainly poor enough to warrant such an opinion. As usually manufactured it is only 21-candle gas ; and, as Professor Lewes has shown, a large percentage of its illuminants consist of the higher members of the methane and olefine series, which are gases at ordinary temperatures. But it is just the very fact that it does not apparently pay to produce a richer water gas which has led the writer to place it third on the list for permanency. If feasible, it would surely be convenient to make a richer gas where enrichment is the primary object sought.

(D) *Hydrocarbon Vapors.*—In this method of enrichment, permanency depends upon the vapor tensions of the liquids employed, which vary with the temperatures and pressures to which the vapors are exposed. The tensions of some of these vapors—say, gasoline, carburine, and benzene at ordinary temperatures—have been experimentally determined ; but when such vapors are added to coal gas, their tensions will be considerably reduced by the solvent action taking place between them and the vapors (usually much heavier) already existing in the gas.

The late Professor Foster stated that, from laboratory experiments, he found "162 cubic feet of ordinary London gas can carry the vapor arising from one gallon of carburine, the temperature of the gas being 59° Fahr., and the pressure normal." This will at once show that, so far as carburine is concerned, we need not hesitate to add to coal gas as much of the vapor as is required for purposes of ordinary enrichment, without fear of subsequent condensation, even at temperatures considerably below 32° Fahr.

IV.—Illuminating Power and Enrichment Effect.

(*a*) Illuminating power—*i.e.*, luminosity per 5 cubic feet when consumed alone :—

Hydrocarbon vapors—	Candles.	
Carburine.....	Unknown to writer.	
Benzene.....	420.0	Quoted by Prof. Lewes in Cantor Lectures.
Toluene.....	741.7	
Naphthalene.....	991.0	
Oil gas, about.....	60	
Cannel gas, average	35	
Carbureted water gas, average	21	

(*b*) Enrichment effect when combined with common coal gas :—

	Candles per 5 Cubic Feet.
Hydrocarbon vapors, say carburine.....	300
Oil gas....	90
Cannel gas, probably considerably more than.....	35
Carbureted water gas, probably slightly more than..	21

Time does not permit of more than a passing reference to the reasons why abnormally rich gases benefit so greatly from mixture with non-luminous combustible or fuel gases. It must suffice to say it has been clearly established that the luminosity of coal and oil gas flames is in most part due to the presence of dense hydrocarbon vapors, which, being endothermic bodies—viz., bodies absorbing much heat in the course of their formation — possess a high potential of stored up energy, which is liberated as heat and light when the vapors are dissociated by the agency of the high flame temperatures due to combustion of hydrogen and methane. This has been

1. See Journal, March 2, 1886, p. 198.

specially insisted upon by Professor Lewes and Mr. W. Young (of Peebles), the latter appearing to have been one of the first to bring these facts to the notice of gas engineers.

The writer would suggest that there is reason to believe that the enrichment effect of evaporable hydrocarbons, oil gas and carbureted water gas may be considerably enhanced by mixing these enrichers with the coal gas in the condensing plant—that is, by putting them upon the same footing as cannel gas. The writer has had personal experience of the advantage derived by such application of carburine and other vapors in ordinary use, and had recently the privilege of communicating to the members of the Southern District Association the results of certain experiments made at the Rotherhithe works of the South Metropolitan Gas Company. He then claimed to have found it possible to raise the illuminating power of common gas one candle by introducing, at a point in the ordinary condensing plant, the vapor of half a gallon of liquid (say, carburine) per ton of coal—*i.e.*, per 10,000 cubic feet of gas. The mean of the experiments made to the date of that communication had shown, therefore, an enrichment effect of 4,000 candles per gallon of carburine and other liquids (some experiments had given considerably more than 4,000 candles), as compared with 1,600 candles per gallon, the highest value previously claimed for the vapor of carburine when added at the inlet of the gasholder—a result due, as he believed, to the retention of more of the heavy naphthaline vapor by the agency of the light vapor of carburine.

The latter figure (1,600 candles) the writer believes to be based upon comparatively few experiments, which, though doubtless carefully carried out by more than one expert, are, he would insist, exposed to great risk of error if made in the works gasholders, owing to the almost invariable presence of naphthaline in the inlet and outlet pipes. Hence, if the liquid is evaporated through the inlet the experiment is almost certainly vitiated by vaporized naphthaline imparting an adventitious value to the enricher. The difficulty may, of course, be partially overcome by introducing the liquid through the crown, and allowing natural evaporation to take place. The writer thinks that few engineers will assert 1,600 candles per gallon of carburine to be their working experience; and he believes this figure to be at least 25 per cent. too high after some years' experience of large quantities of this material. However, for purposes of comparison with other enrichers, the value of 1,600 candles per gallon of carburine has throughout this paper been assumed to be true.

The writer will now be expected to declare whether subsequent experiments have established or discounted his estimate of the average enrichment effect which followed the introduction of carburine and other vapors to the condensers in a series of experiments made during December, January and February last upon a total quantity of (say) 16 million cubic feet of gas, and necessarily upon a working scale. The average value found—viz., 4,000 candles per gallon—has not been maintained; and the later results have varied considerably. The highest in the second series were 4,551 candles per gallon; the lowest, 1,259 candles, and the average, 2,910 candles. These figures, though they do not necessarily ivalidate the results previously obtained, are somewhat discouraging; and the cause or causes have been anxiously sought. In some respects the circumstances have changed.

(1) Sperm candles have been discarded, and Mr. Dibdin's 10-candle Argand pentane lamp, the proposed new parliamentary standard, has been employed throughout. The pentane lamp is far more constant than candles, but certainly not more sympathetic to the gas. (2) The condensing and washing plants have been cleared of the winter accumulation of naphthaline. (3) The output of gas has been largely reduced. The writer believes the lower average result to be traceable to the third of these possible causes. The suggested hypothesis is that there is in every gas works, where the condensing plant is adequate to the make, a point in the condensers where the condensing tarry vapors are so far reduced in quantity as to be no longer sufficient to dissolve all the naphthaline dropping out of the gas, which is thenceforward deposited as a solid, and has to be removed by some other means. As the make of gas decreases this point will be thrown farther back towards the retort house, and *vice versa*.

This is the point where, if anywhere, naphthaline vapor may be retained and carried on to the burner by the employment of lighter vapors as the vehicle of its retention. But to ensure this result it would seem to be absolutely necessary to prevent the accumulation of tar in that portion of the condensing plant through which the added vapors have to pass. Solid naphthaline depositing in the mains may easily prevent the flow of tar to the relief-pipes. To this very cause the lower average of the second series of experiments at Rotherhithe is almost certainly due, for a large quantity of tar was found to have accumulated on the vacuum side of the exhausters, and after its removal the results improved.

The easiest method of overcoming this difficulty is the regular use of a little steam, which is not injurious to luminosity, and need not greatly raise the temperature of the gas—a point, after all, of small importance. Having passed through the washers, the vapors are safe from tarry influences, and are as permanent as when added at the inlet of the gasholder.

It may be of interest to add that, upon the whole of the 34 experiments made to the date of this paper, the highest result has been 6,000 candles per gallon; the lowest, 1,259 candles; and the average, 3,343 candles. Sixteen of these experiments have been made upon carburine vapor alone—the highest result having been 5,076 candles per gallon; the lowest, 1,259 candles; and the average, 3,231 candles.

Determination of the Calorific Value of Coals.

[By Mr. E. Goutal, in the *Gas World*.]

Although chemists are able to accurately determine the elementary constitution of coal and to furnish exact particulars of its percentage of sulphur, ash, moisture, coke and volatile constituents, and even, thanks to Campredon, ascertain the cohesive power of the coke, they have not, so far, succeeded in elaborating any method of estimating the calorific value of coal that will give constant and concordant results, the variations between the figures furnished by different experimenters for the same article amounting to between 10 and 15 per cent.

The author, having been engaged with the analysis, at the Ecole des Mines, of a number of combustible materials of diverse origin, was led to consider the possibility of determining the calorific value in a manner sufficiently accurate for practical purposes without the employment of calorimetric apparatus.

The method proposed by Berthier in 1834, based on the reduction of litharge, was examined and found wanting, because direct calorimetric tests prove that the one part of hydrogen or three parts of carbon capable of reducing one and the same weight of lead to the metallic state, disengage, respectively, 34,500 and 24,420 calories. It is therefore evident that the results calculated from the weight of metal produced will be too low in the case of combustibles containing much hydrogen, and too high in the contrary event. This consideration demonstrates the inutility of attempting to perfect this method, or to alter the multipliers used in the conversion of the weight of metal into calories.

The Dulong formula, in a slightly modified form—

$$Q = \frac{1}{100}\left[8{,}140\,C + 34{,}500\,H - \left(\frac{O+N-1}{8}\right)\right]$$

and that proposed by Mahler—

$$Q = 8{,}140\,C + 34{,}500\,H - 3{,}000\,(O + N)$$

were found to give results fairly comparable to those obtained by the use of the Mahler calorimeter. For example—

	Estimated by— Dulong's Formula.	Mahler's Formula.	Calorimetry.
Pennsylvania anthracite	8,462	8,450	8,256
La Mure anthracite	8,173	8,172	8,216
Kebao (Tonkin) anthracite	8,528	8,531	8,532
Anthracite coal from Commentry	8,333	8,360	8,456
Semi-caking coal from Rochela-Moliere	8,651	8,689	8,767
Caking coal from Saint Etienne, Treuil	8,796	8,829	8,857
Gas coal from Montrambert	8,407	8,494	8,598

On the other hand, the formula given by Scheurer-Kestner and Meunier ($Q = 8{,}080\,C + 35{,}000\,H$) gave results which came out about 5 per cent. too high, as did also those of Cornu and Ser, the former in some instances being as much as 30 per cent. too high, and the latter between 3 and 7 per cent. above actual measurement.

It is, moreover, imprudent to base formula for calorific estimations on the elementary composition of coal as revealed by analysis, there being generally some inexactness in the results furnished even by careful operators; and the analysis performed in industrial laboratories may be prudently considered as illusory, the tedious method of organic combustion analysis being little suited for industrial purposes. It is better to discard formula established on this basis.

Recently O. Gmelin proposed the empirical formula $Q = [100 - (\text{water and ashes})]\ 80 - c \times H_2O$, wherein c is a quantity varying with the amount of hygroscopic moisture present, and valued at—

4	for less than		3	per cent.
6	for between	3 and	4½	"
12	"	4½ "	8½	"
10	"	8½ "	12	"
8	"	12 "	20	"

But this is evidently unreliable, in view of the actual small importance of such factors as hygroscopic moisture and ashes, and, in fact, the results obtained are some 6 per cent. below the truth.

The author, basing on the more important data from the point of view of the heat generated by combustion, prefers to select, on the one hand, the fixed carbon, which has, within very narrow limits, a fairly constant calorific value, and on the other the percentage of volatile substances, their production of heat on combustion being also fairly constant in coals of the same class. From this he elaborates the formula—

$$Q = 8{,}150\,C + A \text{ (volatile matter)},$$

A being equivalent to—

13,000	for volatile matter	between	2 and	15	per cent.
10,000	"	"	15 "	30	"
9,500	"	"	30 "	35	"
9,000	"	"	35 "	40	"

The fixed carbon includes, of course, the coke, less ash, and the volatile matters are assumed as free of hygroscopic moisture.

Compared with the results of the Mahler determination, this formula works out fairly well in most instances.

	Calculated.	Determined.
Pennsylvania anthracite	7,494	7,484
La Mure "	7,448	7,504
Kebao (Tonkin) "	7,712	7,773
Commentry "	7,709	7,850
Blanzy (Ste. Barbe) anthracite	7,757	7,773
Grand Combe "	7,760	7,850
Creusot "	8,371	8,404
Aniche, Ferdinand seam	8,339	8,426
Semi-caking coal, Grand Combe	8,396	8,371
" " Roche la Moliere	8,397	8,417
Caking coal, Lens, No. 8 pit	8,670	8,614
" Roche la Moliere	8,525	8,482
" St. Etienne, Treuil	8,476	8,392
" Carmaux	8,300	8,380
" Anzin	8,026	8,051
Gas coal, Bethune	8,250	8,210
" Lens (Dusouich seam)	8,371	8,395
" Firminy	8,172	8,161
" Montrambert	8,276	8,268
" Commentry	7,947	7,870
" Montvie	7,747	7,798

For lignite and coals of lignitic tendency, however, the method is admittedly less exact. For lignite coal from Decazeville, for example, the calculated value is 7,780 calories, against 7,408 by direct determination, and it is therefore considered advisable to limit the use of the formula to coals containing below 35 per cent. of volatile matter (free from moisture). With this excep.ion it should prove useful to those who do not care to incur the expense of a calorimetric apparatus (which requires delicate manipulation), and who doubt the value of results based on elementary analysis; but for absolute precision direct determination by the calorimeter is the most efficient existing method.

A Suggested Remedy for a Source of Error in Official Photometry.

[Communicated by Mr. LEWIS T. WRIGHT to the London *Journal*.

Despite the very large amount of attention given at various times by scientific men, either acting as individual workers or collectively in the body of commissions, to the now more than ever vexed question of gas photometry and standards of light for use therein, it is doubtful whether within the last 25 years much real progress has been made. In gas photometry, every effort has been made to arrive at a high degree of scientific accuracy—as witness the recent "Instructions" of the London Gas Referees; and yet, after these efforts (and many have been made), we are still beset with troublesome, inconvenient, and inexplicable discrepancies.

Of late it has been the fashion to place all these discrepancies to the evil credit of the standard sperm candle; and numerous have been the inquiries that appear to expose, with much appearance of authority, serious variations in this standard of light. That it is invariable would be too much to expect. It depends upon a complicated phenomenon of graduated combustion that is likely to be effected more or less by external influences. The writer would suggest that the methods by which its delinquencies have been exposed have not always been based upon scientific method. The candle is often compared with some other source of light supposed to be invariable, at least during the series of experiments; and it is then assumed that all the variations are due to the candle. The same inquiries could often be made use of to show that the other source of light was the guilty party, if the equally gratuitous assumption were made that the candle was invariable. It is difficult to say that we know what the extreme variations of the candle may be, or even what may be its average variations.

The simplest plan, failing some invariable standard against which the candle could be compared, would be to compare the candle against itself. If it were invariable, the light from an hourly consumption of 120 grains of sperm would be equal to that from another 120 grains of sperm burning from a similar candle in the same time. If it did not agree, we should know the extent of the variation. We should also know something about the efficiency of the sperm when burned at the various rates of consumption inevitable to this form of illuminant—a subject that, at the present time, is obscure.

The amount of light afforded by the unit normal value of coal or other illuminating gas when turned in an argand burner at a measured rate of 5 cubic feet per hour (a rate that, owing to conditions of pressure and temperature, may not be normal), and afterwards corrected by proportion to 5 cubic feet normal—that is, as if measured at a temperature of 60° Fahr. and a pressure of 30 inches barometer—is not necessarily the same as would be obtained from the same gas had it actually been consumed at the rate of 5 cubic feet normal, because the efficiency at which the gas is consumed by the argand burner varies, with the same gas, with the mass of gas consumed in a given time; and this mass of gas of course varies in the same measured volume with every change of temperature and pressure.

The operation of photometry must be treated as a scientific one; and it loses its *raison d'etre*, if not so treated. Apparatus of precision is employed, and must be employed in a precise manner, on bases that are as free as possible from fundamental sources of error, and that offer a just means of comparing one result with another. The Act of Parliament ruling the case states that the gas shall be burned at the rate of 5 cubic feet per hour. It does not explicitly state that the cubic feet are to be normal for gas, as if at a temperature of 60° F. and a pressure of 30 inches, nor does it say that the results are to be corrected to normal conditions. The London Gas Referees have power to prescribe "the mode to be adopted for testing and recording the illuminating power;" and they have, in prescribing the application of a correction to bring the results to normal volume (and in doing this they have only followed the practice of scientific men before them), interpreted the Act of Parliament as *implicitly* conveying the meaning that the gas volume shall be normal, and as if measured at 60° F. and 30″ bar.—at least, that appears to be the logical conclusion to be drawn from the official practice. It would have been difficult for a body of scientific men to have ignored the variations in the mass contained by the same volume of gas, due to changes of pressure and temperature, and not to have made some effort to avoid the confusion that would arise from not reducing the results to one common basis of comparison by correcting the measured volumes to normal ones.

The system of consuming the gas at a measured volume under the conditions of pressure and temperature existing at the time of the test, and then reducing the result so obtained, by simple proportion, to normal gas volume as if measured at 60° Fahr. and 30 inches, does not necessarily give the same result (and it may give a result differing from the correct one 3 or 4 per cent. either way) as would be obtained from the same gas by consuming it at the rate of 5 cubic feet normal. It does not do so because the London argand burner cannot burn different masses of the same gas in equal times at the same efficiency. No doubt many have thought that to burn the gas at a rate that was not 5 cubic feet normal, and then to correct the result so obtained to a rate of 5 cubic feet normal by simple proportion from a knowledge of what was the normal volume, would give the same result as that which would have been obtained had the gas in the first instance been consumed at the rate of 5 cubic feet normal, when there would have been no need for any volume correction.

This view is erroneous, and assumes what must generally be known to be incorrect—that the burner is able to consume different quantities of the same gas in equal times at the same degree of efficiency. The error due to variations in the mass of gas contained in the same volume measured at different pressures and temperatures, and the inability of

the burner to burn these different masses at the same efficiency, may be considerable, as the writer has pointed out on various occasions. To avoid this error—an error that allows of the same gas being reported of various qualities, according to the unavoidable variations in the mass contained in the measured volume—it is only necessary to consume it at the rate of 5 cubic feet normal; and there are no more experimental difficulties in the way of doing this than there are at present in regulating the photometer meter to make one revolution in one minute. The temperature of the gas is known, and also the atmospheric pressure; and from these data and the present table for the correction of gas volumes the rate that will have to be measured to give 5 cubic feet normal is seen at a glance.

It might be argued that, though the hourly consumption of sperm is to be 120 grains, yet, owing to an inherent impossibility, the rate cannot be absolutely controlled so as to be 120 grains, neither more nor less, and that, though the variation in the consumption of sperm is corrected by calculation, the result is not necessarily the same as though the precise quantity of 120 grains had been consumed, because the sperm, like the gas, does not burn at the same degree of efficiency when being consumed at the different rates, and since it is not possible to secure a uniform rate of combustion in the case of the sperm, there is no need to do so in the case of the gas.

There are two answers to this argument: Firstly, that in a scientific method or practice it is requisite to secure accuracy whenever and wherever it can be obtained; and though occasionally it might happen that the error in the case of the sperm might balance the error in the case of the gas, it would often happen that the two errors would be in opposite directions. Secondly, because an effort has been made already to secure that the sperm consumption shall be within certain limits, by the prescription that if the variation in the consumption be 5 per cent. either way from the normal, the result is to be rejected. Nothing of a definite character is known concerning the efficiency of the sperm candle when consumed at various rates. The prescription referred to indicates, however, that there is something more than a suspicion that the efficiency of the sperm will vary; and the consumption of sperm, to be legitimate for the purposes of official gas testing, is therefore kept within some limits. Nothing, however, is done for the gas in order to keep that within certain limits of efficiency, though it is possible, as has been stated above, to keep it, for the same gas, at the same degree of efficiency.

The foregoing remarks apply to the desirability of securing a method of official photometry that will, in different tests and under the varying circumstances likely to arise at different times, always give to the same gas the same photometric value, and not values that may differ more than half a candle one way or the other from the value it would have if tested, as it purports to be tested, at the rate of 5 cubic feet normal.

Many gas engineers require in their practice to know, within close limits, the photometric values of different qualities of gas, and desire to have a method that tests the gases at the rate of *maximum efficiency* in the burner employed. In following the 5-feet practice, it may happen that one gas is being tested at an efficiency of 75 per cent., while another is being tested at an efficiency of 100 per cent. Some of the very high values ascribed to oil gases after admixture with other gases are due to inattention to this matter.

In order to avoid the confusion resulting from adopting a constant rate for different gases, some engineers have tested gases for experimental purposes at rates that will give, in the case of the argand burner, a full chimney, or a flame that is just short of smoking point. This practice generally brings the gases to a common basis of comparison, and is to be recommended. Another practice also adopted by the writer is to control the air supply to the argand to the point of maximum efficiency. In this manner, the same gas can be consumed in the Argand at widely different rates of consumption to give its maximum efficiency. The writer believes that this method would become very popular if an argand burner fitted with delicate means of controlling the air supply could be obtained. It was found that, by thus controlling the air supply over a range of consumption ranging from 2.86 to 3.93 cubic feet, the same efficiency could be obtained from 17½ candle gas as when the gas was being consumed at the rate of 5 cubic feet without controlled air supply in the ordinary manner. (See article on "The Luminosity of Methane," in the *Journal of Gas Lighting*, Vol. XLV., p. 435.) An advantage of this latter method is that, since the rate of consumption within wide limits is not important when the air supply is balanced to the gas supply, a flame of about 16-candle value can be obtained, and then, without altering the rate of consumption, the air supply can be controlled so as to give the maximum effect; and this can easily be found by observing the disc.

Notes on Residuals.

[A paper read by Mr. Chas. Hunt, of Birmingham, before the Incorporated Institution of Gas Engineers.]

The maintenance of industrial prosperity has in many directions become largely dependent upon the recovery and utilization of waste or residual products. Thus, in the manufacture of basic steel, the residual slag which at one time incumbered the ground is now a source of revenue, the phosphorus which it contains being a valuable plant food. In the early days of gas lighting tar and ammoniacal liquor gave but little trouble to the gas manager, except as to the method of their disposal without offence to the outer world. Now, however, not only are the returns from these residuals keenly criticised, but it no longer passes current that a deficient yield of tar is compensated for by increased production of gas, or that a small return for ammonia is to be wholly attributed to variations in the quality or description of coal carbonized. At any rate, in the author's experience, as stated in a paper read by him before the Institution of Civil Engineers in 1894, "On the Construction of Gas Works," the highest production of gas has been accompanied by the largest yield of tar and ammoniacal liquor; which result, it may be added, has been obtained from small charges of coal carbonized at moderate, as distinguished from high temperatures. This is not inconsistent with the known fact of variation in the yield of tar from different kinds of coal, altogether independently of the temperature of carbonization.

With respect to ammonia, however, the case is somewhat different. It has been repeatedly pointed out by Foster and others that all gas coal contains very much more nitrogen than is represented by the highest yield ever obtained of ammonia; and having regard to the temperature at which this substance may be decomposed, it seems highly probable that much of it is destroyed after formation, by contact with an overheated portion of the retort. Otherwise it is difficult to account for the great superiority of the results which are obtained from a moderate temperature coupled with fairly even charging.

Another nitrogen product—namely, cyanogen, has lately sprung into prominence, due to the use of potassium cyanide in the M'Arthur-Forrest process for the recovery of gold from "tailings." Its presence in coal gas has, of course, long been known, and many years ago it might have been described as the *bête noire* of the dry process of ammonia extraction as occasionally practiced; any appreciable quantity of it rendering the ammonia salts formed in the purifiers practically valueless for artificial manure. Its extraction has formed the subject of many patents, into the merits of which it is not necessary to enter; but until lately the only method practiced was by means of oxide of iron, which, when spent, often contains a considerable quantity of Prussian blue. Spent oxide of iron has, in fact, been for many years treated for this product in Germany, where, owing probably to the presence of a large percentage of cyanogen in the gas, the quantity recovered is occasionally very considerable. Members of this Institution are, doubtless, familiar with the very interesting paper on this subject by Dr. Knublauch, a translation of which appeared in the *Journal of Gas Lighting*. Dr. Knublauch appears to have made a special study of cyanogen in connection with gas manufacture, and may be deemed an authority with regard to it. The gas industry is, however, indebted to Mr. William Foulis, the President of this Institution, for probably, if not actually, the first application of a separate and direct process for the extraction of cyanogen from coal gas, and its production in a salable form. Briefly described, and without going into details, this consists in bringing the gas, after the removal of ammonia, into intimate contact with a mixture of sodium and ferrous carbonate. The hydrocyanic acid contained in the gas combines with the mixture to form ferrocyanide of soda, which is run off from the washer as fast as produced. This crude ferrocyanide is evaporated nearly to dryness in large pans, then ladled out and allowed to cool, when it becomes solid. In this condition it is said to contain about 75 per cent. of sodium ferrocyanide, and was recently salable at about 8 cents per lb.; its value, however, at the present time, owing probably to increased production, is somewhat less.

The quantity of this new residual product which may thus be extracted from the gas varies considerably, all experiments tending to show that cyanogen is essentially a high temperature product. Thus the author has found from experiments that gas which is produced under what may be called moderate heats—namely, from 1,500° to 1,600° F., yields only about ½ lb. of crystallized sodium ferrocyanide per 10,000 cubic feet of gas made (corresponding, roughly, to 1 ton of coal carbonized); whereas, with higher heats, ranging from about 1,700° F. upwards, a yield of from 3½ lbs. to nearly 6 lbs. may be obtained. In

connection with these results, however, it can hardly be without significance that the smallest yield of cyanogen is accompanied by a very abundant yield of the other nitrogen product, ammonia—the average of six months' working being represented by upwards of 40 gallons of 10-ounce liquor per ton of coal carbonized. It therefore appears that the conditions which are unfavorable to the production of cyanogen are favorable to that of ammonia, and *vice versa*. It has been suggested as not improbable, judging from the entire absence of nitrogen in many samples of gas which have been formed at high temperatures, that ammonia at high temperatures, in the presence of hydrocarbon gases, is not broken up into its elements N and H, but that its nitrogen combines with carbon to form cyanogen, $C_n N_2$.

A considerable amount of capital has, it is understood, been already embarked in the production of cyanides by various processes, so that there is evidently amongst manufacturing chemists a very fair amount of faith in the permanence of the demand for them. By no process, however, can cyanogen be obtained so cheaply as by extraction from coal gas, when the circumstances are sufficiently favorable; and as the operation is fairly simple, and the materials required are inexpensive, it may be reasonably hoped that a new source of revenue has thus been opened up which will in some measure redress the balance of the old; that what has to all appearance been permanently lost in the altered value of ammonia may, to some extent, be restored by the utilization of this, practically speaking, new residual.

Although carbonizing in bulk may at first sight appear to be but remotely connected with the subject of residuals, it will, upon consideration, prove to be intimately associated with it. When the Simon-Carvès system of coking was introduced into England some years ago, the author was led to hope that in some such plan might be found a solution of the labor question as affecting gas manufacture, and he so expressed himself in his presidential address to the Gas Institute in 1881. The idea, however, seemed at that time to be almost too venturesome to follow up; but, without being at any time actually abandoned, it has been revived by the rapid and practical advances in the same direction which have been made on the Continent during recent years, and which are, in a great measure, the cause of the fall in value of tar products and ammonia. When on a visit to Belgium with the Iron and Steel Institute during the autumn of 1894, the author was enabled to realize, by actual observation, the large scale on which recovery of residuals is being pursued there in connection with the manufacture of coke for metallurgical purposes, and it was but natural to contemplate what might be the effect upon the values of gas residuals of an extension of the system here, where many million tons of coal are annually used in this industry. In what light, then, ought the system to be regarded? Ought it to be approached as a possible ally, keeping in view its advantages in the saving of labor, or must its advances be watched at a distance, as those of, to all outward appearance, an intractable competitor? To the believer in moderately thin charges as a means of economical carbonization—and who amongst gas makers is not?—this method of carbonization by charges 4 and 5 cubic feet thick and weighing from 4 to over 6 tons can present but little attraction; and yet there has existed, in what has been known of the production of tar and liquor, evidence that the yield of gaseous products by this system does not greatly differ from that which is obtained by the method of carbonizing as employed in gas works. For instance ["Transactions," Vol. II., p. 218], an average production of 10 gallons of tar and 25 lbs. of sulphate per ton of coal carbonized has been claimed for the Otto-Hoffman oven, a type which is largely used in Westphalia, although but little known in England. As, however, recovery of the bye-products is the principal object of the ovens, no steps have, until recently, been taken to ascertain definitely the yield of gas, most of which has hitherto been used for heating the ovens.

Previous, however, to the visit already referred to, the author had been permitted, through the courtesy of Mr. J. H. Darby, to inspect the coke ovens erected by him for the Brymbo Steel Company, which are of the kind known as the Semet-Solvay, and had caused samples of the gas to be taken, the analyses of which gave evidence of its substantial identity with the gas produced in the ordinary way at a gas works. This did not, however, carry conviction at Brymbo, where the gas had a very poor reputation as an illuminant. Accordingly more samples were taken, which at once revealed the fact of large and irregular dilutions of atmospheric air, owing to the exhauster being imperfectly controlled. This defect having been remedied, a marked improvement in the illuminating power was the result, and from that time the gas has been used for lighting the works and offices, displacing the gas which was formerly manufactured for this purpose. The analyses referred to are given below, and compared with analyses of London and Birmingham gas. It is evident that at the first time the samples were taken at Brymbo the ovens were working under a slight pressure; hence no nitrogen was recorded. But on the second occasion a large quantity of air was being drawn in. In other respects there is a very fair agreement in composition with the two other gases with which it is compared, the hydrogen, however, being in excess, and the marsh gas somewhat deficient:

Comparison of Gases.

	From Brymbo Coke Ovens.			London Gas Light and Coke Company.	Birmingham W. St.
	No. 1.	No. 2.	No. 3.		
H_2S	3.8	0.8	0.0	0.0	0.0
CO_2		3.3	0.0	0.0	0.0
O_2	0.0	0.0	0.0	0.1	0.0
CnH_2, etc	4.3	3.7	3.7	4.7	4.9
CO	10.1	9.9	9.8	7.5	6.8
CH_4	29.6	22.9	29.4	34.2	37.5
H_2	52.2	45.9	57.1	49.2	46.2
N (by difference)	0.0	13.5	0.0	4.3	4.6

Nos. 1 and 2 unpurified.

Although here was fairly safe ground to go upon, it was felt that, to set all doubts at rest, the gas ought to be measured, and the illuminating power at the same time ascertained in the usual way. Ultimately the proprietors of the ovens decided to furnish a station meter, so that the actual value of the system for the production of illuminating gas has now, for the first time, been ascertained. Before stating the results obtained it may be useful to describe shortly the arrangements at Brymbo, where the plant is capable of dealing with about 100 tons of slack per 24 hours, and comprises a battery of 25 ovens.

The slack is first washed in one of Robinson's coal-washing machines, which separates about 15 per cent. of impurities. It is then allowed to drain for about 48 hours, and afterwards fed into a Carr's disintegrator, by which it is roughly powdered. In this state it is elevated into a hopper, from which it is supplied to the ovens as required.

The ovens are narrow chambers, about 32 feet long by 5 feet 7 inches high, and are about 15 inches wide at the ram end, increasing to 16 inches at the other. The distinctive feature of this type of oven is that the heating flues, instead of being built in the division walls as is usually the case, are formed separately, so that they can be replaced when needed without disturbance of the permanent portion of the structure. This also enables the sides of the flues to be made thinner, by which the oven is more effectually heated. There are three flues on each side, built one above the other, and running the whole length of the oven. Into the top flues, on the ram end of the oven, a portion of the gas made, after being deprived of tar, ammonia, and light oils, is admitted. It is then supplied with a regulated quantity of heated air, and the resultant gases are drawn by the chimney draught to the other end of the top flue. Here they descend into the second flue, where further regulated supplies of gas and air are admitted, pass again to the front of the settings, and descend into the third side flue. Upon reaching the other end of this the gases pass down from each side into a flue forming the bottom of the ovens, and, flowing along this to the ram end, they reach the main waste gas flue, which is built under ground. Before reaching the chimney, however, they are utilized for raising steam in two Babcock and Wilcox boilers, and are capable of converting about 560 gallons of water per hour into steam of 60-80 lbs. pressure. This is sufficient, when the washing and powdering operations are performed at different periods of the day, for working the entire plant of 25 ovens.

Each oven has three openings at the top, through which it is charged with about four tons of powdered slack, which is supplied from small trucks with bottom doors, pushed from the mouth of the hopper along three lines of rails extending the length of the settings. There is also an opening at the top through which the gaseous products make their way by an ascension pipe into a hydraulic main.

When a charge of coal is burned off, which takes about twenty-two hours, the valve on the ascension pipe is closed, the cap removed and the three covers taken off the charging holes. The iron doors at the front and back of the oven, which extend its entire height and width, are then opened, and the coke is pushed out of the oven, by means of a steam ram, in about two minutes. All openings are then luted up and three truck loads of slack dropped in and levelled with rakes thrust through small openings in the front and back doors. The discharging engine, which travels the whole length of the settings, is supplied with steam by means of swivelled steam pipes. Motion is communicated by two small cylinders to a pinion working in a rack extending the whole length of the ram shaft.

The tar and ammonia are removed from the gas by means of an

hydraulic main, air and water condensers, and a small washer, the tar from the condensers being pumped back into the hydraulic main to lessen the formation of pitch. The tar is sold as such, but, owing to the absence of light oils, does not appear to command quite so good a price as gasworks' tar. The ammoniacal liquor is worked up on the premises into good grey sulphate. A small portion of the gas, on leaving the washer, is purified by lime, and used for lighting the offices and works, being carbureted when necessary with a little benzene. The remainder passes to the absorber or washer, through which about eight gallons of heavy tar oil is run per hour, which removes the light oils from the gas. These are recovered from the absorbent tar oil by steam distillation, the tar oil being then ready for re use. The gas now passes through the meter to the coke ovens, the surplus, after heating which, is used in the adjoining steel works. Provision is being made for measuring separately the gas required for heating the ovens, and it is also intended to treat the gas for the purpose of recovering cyanogen, of which there has been shown by experiments to be present at this part of the plant a quantity equivalent to about 2.7 lbs. crystallized sodium ferrocyanide per 10,000 cubic feet of gas.

During a test of forty-eight hours' duration, the coal used being partly gas and partly steam slack from neighboring collieries, the quantity carbonized was 210¼ tons. This, however, contained about 10 per cent. of water, the quantity of dry powdered slack being 189.3 tons.

The quantity of gas made during this period was 2,158,000 cubic feet (corrected to 60°), or 11,398 cubic feet per ton of dry powdered slack. As about 15 per cent. of impurities is removed from the slack by washing the quantity of gas made per ton of the original dry slack works out at 9,689 cubic feet, or 9,387 cubic feet of purified gas.

The above quantity of coal was carbonized in fifty-four charges, so that 3.9 tons of slack were put in per charge.

Ten observations of the illuminating power were made at regular intervals, the average of them being 15.20 candles when tested at the standard 5 cubic feet per hour rate, and 16.34 candles when tested with the chimney fairly filled with flame, and afterwards corrected to the 5 feet rate. The burner used was the No. 1 London Argand.

The average impurities were—CO_2 2.60 per cent., H_2S 0.52 per cent.

The area occupied by the 25 ovens, with coke floor and travelling room for the discharging engine, is a space about 100 feet square.

It is said that eight months' working of the ovens show an average yield per ton of dry powdered slack of 28 lbs. of sulphate, about 9 gallons of tar and 13.95 cwts. of coke, whilst the light oils recovered from the gas ranged as high as 3.4 gallons per ton, the average, however, being less than this. But if calculated on the original dry slack the figures would be 15 per cent. less. The yield of tar is thus seen to be deficient in quantity as well as quality, although this is probably due, to some extent, to the use of slack, which generally yields less tar than large coal. In other respects the results as to both gas and residuals are comparable with the usual gasworks' method of carbonizing, whilst the duration of the charges, which by this type of oven is reduced to twenty-two hours, as compared with from thirty-six to forty-eight hours with other types, brings this system of carbonizing nearer to the requirements of a gasworks than it has ever been before. It has, however, still to be shown that the ovens can be economically heated with producer gas made from coke or inferior coal, and also that the shorter time occupied in carbonizing is sufficient for the production of the most valuable kind of coke. As to this, it may be mentioned that the coke made in these ovens is spoken of as being superior for blast furnace purposes to that which is made from similar coal in the "beehive" ovens, and also that what is known in the market as "French" coke, from its being made in the Simon-Carvès oven, commands a slightly higher price for foundry purposes than coke made from the same coal in ordinary ovens. Much, however, depends upon the quality and purity of the coal used, and there is still some difference of opinion amongst cokemakers as to the merits of externally-fired ovens like the one described. It is certain that to work the oven system successfully one must become somewhat of an expert in the manufacture of coke, for this, instead of being a secondary, becomes practically the chief product. Moreover, it must be apparent that the system can be employed to most advantage in the neighborhood of the chief manufacturing industries requiring a supply of hard coke, having said which it must still appear that to ally it to the manufacture of illuminating gas would relieve the market of a proportionate quantity of gas coke, and at the same time arrest the increase in the production of residuals, which must be the inevitable result of its independent growth.

The analysis marked No. 3 was of a sample of the gas after it had passed through the absorber, and it is rather curious that it should show the same percentage of hydrocarbons as No. 2. At the same time, however, that this sample was being taken the illuminating power of the gas was above the average, and, unfortunately, a corresponding sample of the same gas taken from the inlet of the absorber was, owing to an accident, not preserved. This would probably have shown the percentage of benzene, upon which the illuminating power of the gas mainly depends, to be comparatively small. The gas, after having passed through the absorber, gave an illuminating power of only 4 candles when tested at the 5-feet rate, but 12 candles when tested with the chimney fairly full of flame, and afterwards corrected to 5 feet consumption. Deprived of the benzene, it still remains a very fair heating gas, very suitable, one would think, for many industrial purposes, although inferior to ordinary coal gas, owing to its containing less marsh gas.

It remains to be mentioned that the whole of the analyses and tests referred to in this paper were made by Mr. E. L. Pryce, an Associate of this Institution.

Single Phase Self-Starting Synchronous Motors.

[From a paper by Mr. F. H. Leonard, Jr., before the National Electric Light Association.]

Every central station manager who operates an alternating plant has to grapple with the question of power distribution. Applications for power service come in from every direction, and in many cases, properly worked up, would make a more remunerative business than that of furnishing current for lighting purposes. It is, perhaps, unnecessary to point out that the bulk of the lighting service averages but a few hours per day, whereas the motor service covers a much longer period, with a corresponding reduction in the cost of the current output. The difference is so great that many stations are furnishing current for motor service at 50 per cent. of the price for lighting service, and even then figure that the motor business is the more profitable.

The drawback to the single phase synchronous motor has heretofore been that it could not be started without some other source of power, and would not carry its load up to speed. Motors are now made in which this is entirely overcome. They start up under load, and can be specially wound to give much greater torque in starting than when running in synchronism.

Two simple, well-known principles are combined in this motor: The principle of the ordinary alternating current synchronous motor with that of the direct current motor or generator. The armature has two distinct windings; one a distributed winding connected to a commutator, similar to that of a direct current motor or dynamo, which in this motor is used for starting and afterward for exciting the field; the other winding is of the shuttle type, wound so as to concentrate distinct and regularly alternating poles in the armature, and performs the regular work of rotating the motor armature, advancing it from one pole to the next with each impulse of the generator.

An ordinary double-throw switch on top of the motor is used in starting, there being no resistance or other complicated device, as the self-induction of the winding is sufficient to choke back any abnormal flow of current. In starting, the switch handle is depressed so that the lead wires which conduct the alternating current from the transformers are connected through the switch blades to the contacts which lead the current first to one of the commutator brushes, thence through the distributed armature windings, and out through the opposite brushes to a coarse wire winding on the field poles, and back again to the switch contacts and binding posts, these connections being identical with those of a direct current series motor. As soon as the current is turned on motor commences to rotate at a constantly accelerating speed until synchronism is reached, which is indicated by the lighting of a lamp, located on the switch, at a dull red. This is the signal for the reversal of the double-throw switch, which then changes the complexion so that the leads from the transformer are cut off from the commutator and connected to the collector rings and concentrated armature windings, while at the same instant the commutator brushes are connected to the shunt field windings, magnetizing the field with direct current, the only office of the commutator, after the motor is started and up to speed, being to supply the small direct current necessary to magnetize the field.

In starting without load the motors will run up to synchronous speed in from 5 to 15 seconds, depending upon size, windings, etc., and when loaded in from 15 to 30 seconds, taking about the same current

in either case, the time factor making the difference in the power consumed; the current taken under these conditions amounting to from 25 to 50 per cent. in excess of what the motor will require when running in synchronism. But when only required to start itself for light countershafting, this current may be greatly reduced by special windings.

The direct current winding delivers a perfectly smooth current and is not at all pulsating in character. In circuit with the field winding is a rheostat to control the extent of field excitation. This rheostat is located in a recess in the base of the motor, the handle for its regulation being accessible through the oval opening at the commutator and pedestal. The motor, starting switch and field rheostat are in one piece, making a most simple and compact combination. All that is necessary to install the motor is to connect the secondary wiring of the transformer to two binding posts on the motor and it is ready for operation.

The field crown is of the multipolar type, with field cores pointing inwardly; the magnetic circuit is composed of sectional sheet iron punchings, each section including two poles, stacked so as to break joints. These punchings interlock and are clamped between two cast-iron rings with bolts passing through from side to side, which serve to clamp the whole together solidly, at the same time holding each punching in its proper place and tying them like links in an endless chain. The bottoms of the cast-iron rings are milled to fit the base of the motor, to which they are firmly bolted.

On top of the field crown is placed a starting switch, and all the electrical connections from fields, commutator and collector brushes are brought around the outside of the field punchings to the top, concealed from view, however, by the perforated steel jacket, which is held in place by grooves in the cast iron clamping rings, forming an ornamental finish and greatly increasing the radiating surface.

As this motor runs at a constant speed it has been necessary to devise several arrangements to accomplish what might be done by variable speed motor. Motors are made for blowing church organs, in connection with which it has usually been customary to provide complicated automatic speed regulating devices. With this motor no attempt has been made to vary the speed. The organist closes his circuit and starts his motor by means of a pedal. A blower, driven by the motor, fills the bellows and maintains a constant pressure, usually about 4 ounces per square inch. If no air is used the blower spills the wind out of its fan and requires only enough power to overcome the friction and maintain the pressure. As fast as the air is used the blower takes a corresponding amount of power, the motor absorbing the current accordingly.

An arrangement for elevator service which is extremely simple has been devised. The constant speed alternating motor, cable drum and gearings are all mounted on a single base casting, in which the respective parts are bolted. There is a pinion on the shaft of the motor which engages two bevel gears, each mounted on a sleeve, which also carries one part of a friction clutch, the two sleeves rotating in opposite directions, and the whole being supported by and turning freely on the worm shaft which engages the worm wheel that turns the cable drum. The other part of each clutch is keyed to the worm shaft. The controller wheel is mounted on an extension which is cast on the case that entirely incloses the bevel gears and pinion, permitting them to run constantly in oil. This controller wheel is connected with the controller cables or hand ropes which serve to operate the elevator. A pull on the hand rope turns the controller wheel, rotating it through an arc of 60 degrees. This rotation serves, first, to release the brake on the worm shaft, by means of the adjustable link and lever, by depressing the roller which travels over the cam in the controller wheel; at the same time one shipper fork is moved by the connecting rod at its upper end, which is pivoted near the upper rim of the controller wheel, far enough to cause one of its clutches to engage its other part on the sleeve attachment to the bevel gear, so as to drive the worm shaft and rotate the cable drum. At the same time the connecting rod attachment to the shipper fork opposite moves across the center of the controller wheel without producing more than enough movement to take up the lost motion in the clutch parts to which it is attached. Pulling the hand rope in the opposite direction brings the parts back to their original position, disengages the clutch and sets the brake on the worm shaft. Pulling still further in this direction the opposite connecting rod travels so as to move the shipper forks and engage its clutch, turning the hoisting drum in the opposite direction, while the first mentioned connecting rod moves across the center without causing any appreciable movement of the shipper fork. The motor runs continuously in one direction during working hours, and there is no heavy rush of current in starting, as with a direct current series motor, with its tendency to drop the brilliancy of the incandescent lights on the same circuit.

These motors are suited to any frequency in general use in this country, and are wound for from 140 to 60 complete periods per second, the speed being fixed by the frequency of the generator or circuit to which it is connected.

While this motor was designed for single phase circuits, yet it is obvious that it will work quite as satisfactorily when connected to either leg of a two or three phase circuit, and where such circuits are loaded with induction motors a few synchronous motors properly distributed and somewhat overexcited would serve to allay the pernicious effects of the inherent lag or idle current which goes with induction motors, at the same time raising the e. m. f. at the extremities of the line, reducing the drop in the conductors and allowing the generators to do more work, inasmuch as they would not be required to deliver so large a wattless current.

This synchronous motor is also a good rotary transformer, and lends itself very conveniently for charging storage batteries and electrolytic work, the alternating current entering at collector rings, while direct currents are delivered from the commutator brushes. For laboratory work and as a piece of apparatus in colleges that teach electric engineering it is invaluable; for, besides the previously mentioned uses, it may be driven by direct currents as a series motor; further, it may be run at a constant speed as a direct current shunt motor, while from the collector rings alternating currents may be taken at any frequency, dependent upon the speed, which can be regulated by resistance in the field or armature circuits; or, belt driven, it may be used as a self-inciting alternator.

Something About Packing.

[By Mr. W. H. Wakeman, in the *Safety Valve*.]

The first joint that I ever remember having trouble with was the manhole cover of a tubular boiler, the first one of the kind that I ever had to do with. After running the boiler a few weeks I felt anxious to see the inside of it. At the first opportunity I opened it, found but little loose scale there, and then proceeded to get it together again. As this was when I was one of what is now termed "the much advised young engineers," I had not provided an extra gasket for the cover, and was consequently in a bad fix. The main belt on the engine was rubber, and as there was a piece of it left after using all that was needed to run the machinery, I pressed it into service and cut a gasket out of it. Putting this carefully into place and screwing up the nut on cover, water was admitted to the boiler only to find a leaky joint that no amount of screwing up would stop. Finally it was necessary to take it out and send for one made of pure gum, or at least it had the name of it, when the joint was made up without further trouble. As this was where no city water under pressure was furnished, we depended on an elevated tank for water to fill the boiler, and as much of this had been used up while trying the joint, it was necessary to fill the boiler by hand, and this is what impressed it on my mind, so that ever since I have been partial to gaskets made of thick, tough but yielding rubber for this place. Some prefer rubber tubing for this purpose, and it answers well, but the joint in the tubing should be well wrapped with twine in order to make it tight. A metal gasket is sometimes used for this place and would probably answer a very good purpose if the surface was nearly smooth, but my experience has been that after once using, it is a hard matter to make a tight joint with one of them. Rubber gaskets may be used more than once, if one side is coated with chalk or graphite, or if a piece of manilla paper be put between the gasket and the boiler.

When packing the cylinder head of the engine in this factory, I used to take a piece of sheet rubber, cut out a gasket the right size and use the piece that came out of the center for other purposes. After getting acquainted with a man in charge of a 34-inch engine, I asked him how he managed to pack his cylinder head. He replied that he took a piece of candle wicking worth about 4 cents and laid it on the joint to be packed. Sometimes he put it on so that it came outside of one stud and inside of the next one, in order to keep it in place. I have used up no more sheets of packing for this purpose since then, but prefer asbestos wicking to any other, and lay it on the cylinder head, tight up in the corner formed by the projecting part of it, using some cylinder oil to assist holding it in place. When making a joint in the wicking, remove one strand from each end for about 2 inches, and then twist these ends together, and a smooth, endless piece will be the result. This applies to steam chest covers on engines and pumps.

One of the worst things to keep packed that it was ever my misfortune to have charge of was a line of cast iron pipe working under 80 pounds steam pressure when in use. The faces of the flanges were not turned smooth, nor even roughly trued up, but were left just as they came from the foundry. What made the matter much worse was the fact that the stop valves leaked, making it necessary to get steam off from the boiler every time that a gasket blew out, until an opportunity came for repairing the valves—and such opportunities were not very close together in a jobbing mill when business was good. Two or three brands of packing have been invented since those days, for which we are truly thankful. An asbestos gasket lasted about as long as anything we could get then. When packing such joints care should be taken to prevent any of the pieces of old packing from falling into the pipe, for if they are carried to the engine they will probably do some damage.

Some kinds of sheet packing that are furnished us for packing flange unions soften with the heat and spread out under pressure. In such cases the hole should be cut larger than the pipe calls for, or else the packing will partially close up the hole when well heated. Such packing needs attention, especially at first, for if it is put in cold and no further attention paid to it, when steam is admitted it will expand, and after it has been cooled off and heated up again it will be found loose, and unless attended to will be blown out of place. When such packing is used it must be warmed up gradually, and the nuts screwed up as fast as may be necessary to keep the pressure of the flange on the packing. After the surplus packing has been squeezed out the flanges will be nearly in contact, and the packing will probably last for years under favorable conditions. Packing is now on the market that does not yield so readily to the influence of heat, but will hold its own better when first put in. How well it will wear time alone will tell. The use of copper gaskets for packing flange unions has proved a valuable innovation in some cases, for they cannot blow out under pressure. It should be remembered, however, that the copper gasket will not pack a rough joint, but where the flanges are turned smooth it will last for several years. Sometimes an annealed copper wire is used for this purpose, having the ends soldered together. Also copper in square form with grooves cut into it, in order that it may more readily conform to rough surfaces.

Probably no other job of packing that an engineer has to do requires so much good judgment as packing the piston rod of an engine. The first rod that I ever packed was run with soapstone packing. This answered every purpose there, and probably will elsewhere if the rod is perfectly in line. Where a rod is even slightly out of line, and I believe that but few of them are running perfectly true, it requires packing that is elastic, so that it will "give and take," as engineers sometimes say. To secure this qualification it must have a rubber core or a rubber back. If it has a rubber core it is evidently an advantage to have the core flat, so that when the gland is screwed up it will tend to expand the rubber crosswise of the rod to a greater extent than if it were round. At least one firm (and perhaps more) manufactures a piston rod packing that will just fill the space between rod and gland, being made all in one piece and split on one side in order that it may be sprung apart and put onto the rod. This is a very good plan indeed, but it is necessary to take measurements and send them the exact size of the piece wanted.

In one case, where the engineer was naturally of a very economical disposition, he used to pack his piston rod with pieces of garden hose wound with hemp. It is a fine Corliss engine, and is not located in the woods either. He has come to the conclusion that it is poor policy to run the risk of ruining a splendid piston rod for the sake of saving a small amount on packing, and so has concluded to use a good grade of standard packing hereafter. We admire his judgment.

Metallic piston rod packing is rather expensive at first, but usually proves to be a very good investment, even when viewed from the owner's standpoint, and especially so to the engineer in charge, as it not only saves much time for him, but does away with the necessity of doing disagreeable work at times when other people are in bed.

There are, however, several inferior brands of metallic packing in the market which should be investigated and avoided. One disadvantage of this kind is when it begins to leak it cannot be stopped as readily as when fibrous packing is used, but still it pays, because it should last five years without repairs, and as a rule a renewal of some of the parts makes it as good as new. I know of one engineer who had much trouble with his piston rod packing, until one day the proprietor sternly demanded a statement as to whether he could pack that rod so that it would not leak or not. An answer in the affirmative came just as promptly and sternly as the question did. He cleaned out the stuffing box neatly and melted some babbitt metal and poured the box full except a space left for the gland to enter, finishing by caulking it solidly into place. The result was that there was no more leaking as long as the engineer stayed there, but while relating it he expressed sympathy for the man that should be obliged to remove the home-made metallic packing. If any reader follows his example let him do it on his own responsibility, for I only repeat the story as it was told to me. It worked well in that case, but it might not in some other.

An engineer should not screw up the nuts holding a piston rod gland in place until he knows what kind of packing is in the box, as some kinds of metallic packing are so made that you cannot injure them by tightening them, while others are wedge-shaped and adjusted the same as fibrous packing is, except that if screwed up too tight the metal will at once bind on the rod and something will be damaged.

The valve stems of Corliss engines were originally fitted with stuffing boxes for fibrous packing, but the motion is such that they prove to be hard places to be kept packed tightly, and furthermore if they are not packed right it affects the closing of the cut-off valves, especially where they are not fitted with vacuum dash pots. It was a great improvement when someone conceived the idea of making a ground joint inside of the valve chest that enables us to dispense with the stuffing box. This ground joint does not always remain tight, however, and when it begins to leak and steam and water blow out through the oil hole and around the stem near its end, the engineer is helpless until such time as he can shut down for repairs. The best arrangement that I have seen for this place is a loose collar on the valve stem on the inside of the valve chest, and a stuffing box on the outside. In this way but little pressure is brought to bear on the packing and it will last for a long time. When in charge of a Corliss engine built in this way it was my custom to repack the valve stems in January and July of each year, using asbestos wicking well lubricated with cylinder oil, and the packing was removed then because it was beginning to get hard and not on account of its leaking steam.

It is considered proper, I believe, to only tell of the good qualities of those who are absent, but I will ignore that rule to the extent of saying that my predecessor used to pack these stems with a finely-braided hard round packing, and he left it in place so long that the marks of it on the valve stems were painfully evident to the sense of sight and feeling—hence the adoption of asbestos wicking as an improvement. It was my custom to take six pieces of this wicking and twist them into a rope, which made it the right size to comfortably fill the space allowed for packing. I found it better to break the wicking into pieces the right length rather than to cut them, for in the former case it left tapering ends that would nicely lap without making a bunch, while in the latter, square ends would be left, requiring the packing to be exactly the right length, or else a gap or a double thickness of packing would be the result. When putting these pieces into place I had one joint come on top and the next one on the bottom. A globe valve that requires no packing for its stem has been invented, but is it durable? If a valve stem is leaking steam in a room filled with people, it is an easy matter to remedy the trouble, with the ordinary valve; but suppose that it is some patented arrangement with metallic packing or substitute for packing, what shall we do in that case?

Some of the valves that we have are so made that when the valve is unscrewed the packing is retained by the stationary piece or bonnet. Some engineers like this arrangement I suppose, but not all of them, for when packing a valve stem, if we do not get quite enough in the gland at first and unscrew it to put in more, it is exasperating to find all that we have so carefully packed in it roughly pulled out. I believe it to be better to leave the top of the bonnet perfectly smooth. When putting fibrous or wick packing around one of these stems, wind it in the opposite direction from which the gland will turn when it is screwed down, and the end of the packing will be left in a way to be pressed smoothly into place, while if wound in the opposite direction the reverse would be the result.

Some of the new valves that we get have but a very small space for packing, making it a very hard matter in some cases to get the old packing out when it is necessary to renew it. It saves a small amount of cheap packing, but is poor economy as a whole. I have found it a good plan to cut pucking rings out of rubber belting for valve stems where sufficient space has been provided for it, as it makes a very good packing for them. Do not try to cut them out with your jackknife, for you cannot get them perfectly round and the scheme will be a failure. Get a washer cutter consisting of two knives or cutters made to slide in a slotted yoke, revolving round a spur or sharp prong set in the piece to be cut, the whole to be operated by a common car-

penter's brace. When cutting the ring, in order to get it around the stem, cut it on an angle and not square across.

I have been amused to note the way in which some people pack their gauge cocks. I refer to the kind so commonly used, which are packed with a strip of rubber packing about three-quarters of an inch wide. In one case a man packed his with leather and left about eight inches of it hanging on one side of the gauge cocks. When asked what the object was he replied that when one part was worn out he could pull it along and have a new place to work on. I should think that such a man would keep his clothes on all night in order to save dressing himself in the morning. In another case an engineer had gate valves put between the boiler and the cocks, and when asked the reason for it said that it was so that he could pack the cocks at any time when the pressure was on the boiler. Having used these cocks for several years and never found any trouble in packing them whenever they needed it, I was somewhat surprised at this intelligence. My experience has led me to believe that it would be more trouble to keep the valve stems of the gate valves packed and the valves nicely polished than to pack the gauge cocks.

I am not sure but that glass water gauges can be packed like valve stems with asbestos wicking, but I have never had any success along that line, although we hear that others can do it. Sometimes such things are considered failures, because what one man calls success another man is not all satisfied with.

Although we occasionally find packing that is not entirely satisfactory, still we cannot but rejoice that the old red lead and hemp joint for flanges and twisted hemp for piston rods have gone out of date never to return, for like some other things that we might mention their usefulness is a thing of the past, and we have no desire to see it restored.

The Making of a Boiler.

[By Mr. Fred De Land, in *Electrical Engineering*.]

A continuous, deafening noise greets the ears on entering the long, substantial brick buildings, 100 feet in width by 300 feet in length, and ascending the short stairway to the glass-encased offices overlooking every department. From these windows that ward off the sharp, penetrating, never-ceasing din may be seen the embodiment of the latest ideas in boilermaking, here put in practical use, in the belief that with abundant capital, improved machinery and modern methods, a superior type of water-tube boiler may be built at a minimum cost, yet containing every essential feature that distinguishes the efficient from the inefficient, uneconomical steam generator.

For a boiler should be simplicity itself, and consist only of steel tubes and plates of steel shaped to suitable design and firmly united by rivets, and in the forming of the plates of steel and the assembling and testing, lies the making of a boiler. Lap-welded tubes of the desired lengths and diameter are received direct from the tube works, while the rolling mills send the steel plates already sheared to order. The rivets are sent from the rivet works. And yet a thousand and one little details enter into the shaping of the plates and the assembling of the parts, many of which require the highest degree of accuracy, huge and unwieldy though a boiler be. Each plate must be gauged and careful measurements taken to indicate by marks where holes are to be reamed through which the rivets will pass, or how much may be beveled or trimmed from the edges to insure a perfect lap. As all the machinery is operated by electric, pneumatic or hydraulic power, it requires but a few moments of time to cut and ream the necessary holes even in a plate of inch steel, or to plane off the edges as smoothly as though the shaving was soft pine in place of flange steel, or for the long bending roll to receive a plate of steel 20 feet in length and bend it into the form of a drum as easily as a child would bend a bit of heavy cardboard. Formerly it required the constant labor of five men to make two heads or tube sheets a day for these drums, but now each day may see 20 or 30 massive steel plates, 8 feet in diameter, and from ¼-inch to a full inch in thickness, lifted with aid of crane and fork within an oil-heated furnace, wherein they rest on steel rails that in turn are supported on fire-brick. Then, as soon as the plates attain nearly to a white heat, the doors of the furnace are opened, and crane and fork quickly transfer the heated plate to the table of an enormous hydraulic press, pressure to the extent of from 400 to 500 tons is applied, and in less time than it has taken to write these words the edges have been turned and a perfect head formed. Then without loss of time the head is quickly removed from the table to prevent the steel, in cooling, from shrinking fast on to the former or die.

After cooling, the head or tube sheet, as the plate is now called, is picked up by the crane and carried to the horizontal punch, which cuts a series of holes through steel templates for the circumferential seam, all punched holes being afterward bored out to exact size for the rivets by pneumatic reaming tools, after which it is passed on to the radial drills, where the tube holes are accurately marked and then bored out. Then the crane again picks up the head or tube sheet and carries it to the boring mill, where the edge is beveled off to the proper angle. From thence it passes to the assembling floor, where cylinders and heads are joined with temporary bolts, and the two carried to the hydraulic riveter and riveted in rows of two, three, or four; the longitudinal and the circumferential seams are riveted under pressure of 60 tons. Again these two, now designated as the steam drum, are carried to the assembling floor to receive the tubes, which are inserted through and so expanded within the corresponding tube holes in the tube sheet as to form a shoulder on the tube on each side of the sheet, holding the tube firmly in place; also resulting in a connection so close and intimate as to insure a steam-tight connection under all conditions. Then the ends of the tubes are beaded down close to the tube sheet, after which the tube is again expanded. This tube sheet forms the bottom plate of the steam drum. Then the top head of the steam drum is riveted on. A similar process is followed throughout with respect to the water drum into which the lower ends of the tubes enter. The water drum is also provided with four cast-iron lugs or brackets, firmly riveted to the lower part of the shell of this drum. These lugs form the support for the boiler by resting directly on the foundation when boiler is erected, and leaves the entire boiler perfectly free to expand, when heated, without causing any undue internal strains in any part of the structure. The top head of the steam drum also carries all the hand-holes arranged for the rapid removal of tubes that may ultimately prove defective, and the openings for the steam and pop valve outlets. Both drums are provided with manhole openings (with swinging-hinged man head) for admittance to the inside of the drums and tubes for cleaning out and repairs—these two manholes being the only openings necessary to allow of the most thorough inspection of the entire interior surface of the boiler.

The longitudinal and circumferential seams are now ready for calking—that is, the battering down of the seams to insure a steam-tight joint—and the work is done by pneumatic calking machines receiving air from the compressor under a pressure of one hundred pounds to the square inch. This calking machine strikes about 2,300 blows per minute, or nearly 40 per second; and while it is the best possible method of accomplishing this work, yet it is of so noisy a character that it is a matter of surprise that some of our quiet-mouthed political leaders have not utilized it for drowning the untruthful remarks of the opposition at party gatherings where harmony is desired; and when the calkers are reinforced by the roar of the blast from the oil furnaces, the combined noise nearly equals but is productive of more benefit to the country than the yap of some of the politicians. The fittings for each boiler—that is, the safety valves, water column pipes and connections, blow-off pipes, soot-cleaning pipes, steam-gauge pipes, etc.—are all fitted in the machine shop, the valves, gauges, etc., being purchased of the most responsible makers.

As the boiler is now ready for testing it is carried by the 25-ton crane to the testing floor and completely filled with water. Then, by means of a pump, water pressure is applied to an amount more than 50 per cent. in excess of any steam pressure the boiler is designed to carry, and any defects that may have crept in, either in the material or in the workmanship, are then detected. Should a defective rivet be found it is immediately cut out and a new one substituted, and if a seam proves leaky it is recalked, that these may at all times be absolutely water-tight and steam-tight.

As this testing practically completes the boiler proper, it is now turned over to the painter and then to the shipping department. But while all this work has been going on the foundry and machine shops have each been kept very busy getting out their allotment of the accessories of a boiler. All the castings for the fire fronts, the grate bars, the cleaning doors, that permit of the removal of soot from the outside of the tubes, and all other castings or fittings necessary for the furnace portion of a boiler plant are assembled within the machine shops for shipment with the boilers.

The smoke stack supplied with the boiler is built up after a some what similar process as the boiler itself. The sheets of best chimney steel are laid out, punched for riveting and then assembled to make stacks of varying diameters and heights, as desired. Each stack has swinging dampers in the base and suitable openings for cleaning, and are supplied with reinforcing bands to guy the stack firmly to the ground to limit swaying and prevent overturning. To place a boiler in service requires the best of fire brick for the furnace walls, suitable foundation and brick encasing walls; thus the brief description here presented covers merely the completed tabulated shell within which the steam is generated.

The Cripps Improvement in Purifier Construction.

On the 2d inst. U. S. Letters Patent (No. 561,203) were granted to Mr. Frederick Southwell Cripps, of London, England, for improvements in purifier box construction. Using the words of the specification:

This invention relates to improvements in valves for use in connection with purifiers employed in gas works.

This valve is so constructed as to admit of by-passing any layer or layers of purifying material in the apparatus known as "purifiers" in gas works. It is designed to be fixed at one or more of the lower tiers of sieves or grids carrying the purifying material, so that in the case of excessive back pressure being given by any particular layer the valve can be opened and render immediate relief by by-passing that layer only. Then instead of having to force the gas through the purifying material, which has become used up, choked and hard, it can be passed direct to the fresher and more open material above, thereby obviating the necessity of changing the purifier simply on account of the material in the lower portion being choked. The valve is fixed inside the purifier, but it is actuated and worked entirely from the outside of the purifier.

It consists, essentially, of three (3) parts, viz.: the body, the valve and the gear for opening and shutting it; but in order to render the nature of my invention clear I refer in the following description to the illustrative drawings, of which—

Figure 1 is a sectional elevation with the gearing situated above the valve. One half shows the open ways through the valve and seating and the other half the solid webs of the valve and seating. Fig. 2 is a plan showing valve open for passage of gas. Fig. 3 is a section showing the gearing when placed below the valve. Figs. 4 and 5 are elevations showing the manner of fixing same in purifiers.

The body *A* is a rectangular or circular pipe casting, prepared with flanges *B* for fixing to the side plate of purifier in such a way as not to damage or weaken the same. The body is of about the same depth as the layer of purifying material through which it passes, and around its bottom edge a shelf *C* is cast to carry the sieves abutting against it. The upper end of the body is divided into several segments, half of which are open *D*, and half are solid *E*, alternately, and in the center is a boss *F* for carrying the valve spindle. The upper edges and surfaces *G* are faced to form the seating for the valve to work upon. The valve *H* is a circular disk or grid valve of cast iron, turning on a center pin *I*, and having divisions alternately open *D* and closed *E*, being in this respect the exact counterpart of the faced body on which it works. A lip *J* projects downward, so as to clasp the circular face and seating on which the valve works and excludes grit, etc., from the working faces *G*. The under surfaces and lip are faced, and it is provided with means for lubrication in all working parts.

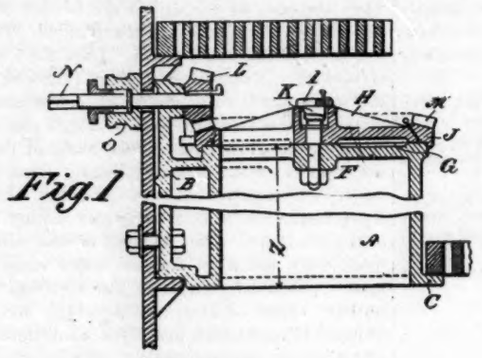

Fig. 1

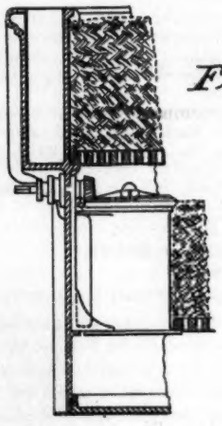
Fig. 4

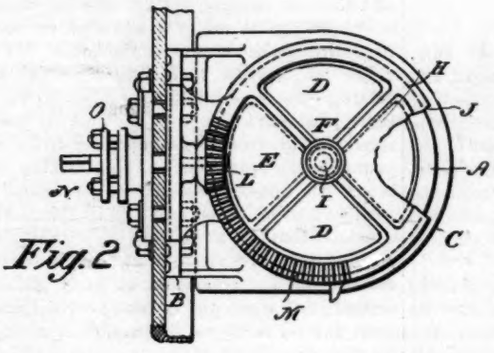

Fig. 2

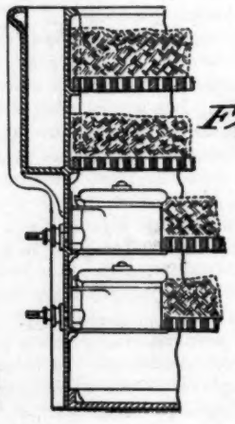
Fig. 5

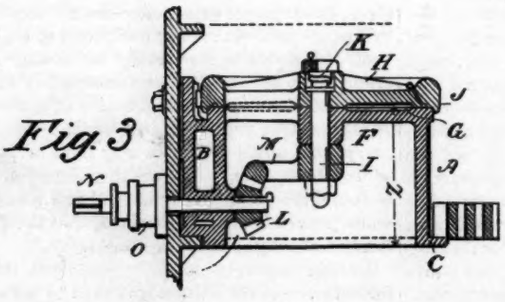

Fig. 3

In addition to the weight of the valve keeping it down on its face a volute spring *K* surrounds the center spindle, causing increased pressure between the surfaces and insuring perfect gas tightness, so that gas shall not pass the valve when it is shut. The gearing for actuating the valve consists of a bevel pinion *L* and wheel or segment *M*. The wheel or segment is either cast solid on the rim of the upper surface of valve, or is in a separate casting fixed below the valve, as in Fig. 3. In the latter case the valve and wheel or segment are both fixed to the center of spindle *I*. The pinion is turned by a short spindle *N*, passing through a small stuffing-box and gland *O* on the purifier side plate, and a guide bracket or boss cast on the body.

A quarter turn of the valve will open or shut it. Stops are cast on the valve and body to indicate when the valve is fully open or shut. It is constructed and fitted so that no faces are uncovered or in contact with or exposed to the action of the gas or purifying material when the valve is either open or shut.

The depth of the body *Z* is made to suit the pitch of the sieves or the depth of purifying material in the purifier.

Having thus fully described the nature of the said invention, and in what manner the same is to be performed, I declare that what I claim is—

1. In a device of the class described the combination with a series of sieves and adjacent side plates arranged in tiers, of a valve casing secured to each plate below the sieve of the tier next above and pro vided with a seat and ports, a valve arranged to move in said seat and open or close the ports, a rotary shaft for the valve extending therebelow, and a pinion meshing with the gear to contribute motion thereto.

2. The combination with a sieve and adjacent side plate, of a valve casing secured to said plate and provided with a seat and ports, a valve arranged to move in said seat and open or close the ports, a rotary shaft for the valve extending vertically therefrom and a pinion meshing with the gear to contribute motion thereto.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Brooklyn Union (N. Y.) Gas Company has taken the first positive step towards reorganizing and consolidating its manufacturing plant, in that it has disposed of the site formerly occupied by the works of the Peoples Gas Light Company. The land, which faced on quite a valuable bit of water front on the East river, is said to have been purchased by the Mollenhauer Sugar Refining Company, the factory of which concern is convenient, in fact, if not adjacent, to the gas works site.

MR. CHARLES R. PRICE, Treasurer of the New Bedford (Mass.) Gas and Edison Light Company, writes that the Company's gas stove sales show a satisfactory increase, which will easily be understood when it is further said that the number placed so far this year is over double the number placed in the corresponding period in 1895—and '95 was a "good stove year" with the Company at that. Mr. Price and his associates evidently intend to move onward in this direction, as witness our mention in the JOURNAL for June 1st of the Company's new selling rate schedule, named to go into effect on July 1st. Under that schedule the net rate per 1,000 to ordinary consumers is $1.35; and the net to "extraordinary" users (in this case "extraordinary" is to be interpreted as meaning a use of 4,000 cubic feet per month or over) is the extremely low rate of $1.13 per 1,000.

THE following interesting letter came to hand from a correspondent, under date of June 10th. The writer prefers to remain incog., which we regret, in that he is not given to making statements that are not thoroughly supportable.

To the Editor AMERICAN GAS LIGHT JOURNAL: In the works of which I have charge our benches contain five and six retorts each; the 5's are half regenerative style, with capacity of 45,000 to 50,000 cubic feet of gas per bench in 24 hours. The consumption of gas during the summer months falls as low some days as 30,000 cubic feet. You will, therefore, note that only about two-thirds of the day would be required, with one of these settings, to produce sufficient gas for the 24 hours' consumption. It being necessary to keep up heats during the entire day we would be at a loss of one-third more fuel than was necessary to produce the amount of gas required. Studying over this, endeavoring to find some way in which to save this waste of fuel, I finally decided on charging the retorts with slack coal, "when not otherwise used for gas making," to obtain the coke, tar and ammonia, but after getting lowest prices possible on slack delivered, and carefully figuring out the value of coke, tar and ammonia I would obtain, I found it would not be profitable. After further consideration, however, I decided to obtain the slack, enrich same with cannel, and use it entirely for our production of gas during the summer months. This, I am pleased to say, has proven beneficial. The same labor I would otherwise have had to employ is sufficient to keep the one bench in constant operation, making in 24 hours, with slack coal, what I could with lump coal make in 16 to 18 hours, but laying up a good sized pile of coke for next winter (for which we have a good sale), besides increasing our revenue from tar and ammonia. I am at present producing gas of good quality for about 8 cents per 1,000 cubic feet less than it has ever before been produced at these works. The coke, if allowed sufficient time to burn dry, is fairly good, the tar is about ordinary in quantity and quality, and the ammonia is somewhat better than that obtained from *our* lump coal. I am very much gratified over results obtained, and hope this little item may interest some other similarly situated gas engineer.

A NEWS item in the San Diego (Cal.) *Sun* is to the effect that Mr. L. P. Lowe and his associates say they will be in readiness to supply gas in San Diego by December 1st. The Company incorporated by the Lowe syndicate is to be capitalized in $200,000 and bonded in $100,000, which ought to be ample. Meanwhile, if we owned any shares in the old San Diego Gas and Electric Light Company (even though it is capitalized at a figure very much in excess of the one named for the opposition Company) we would not be in haste to sell the same.

THE plant and franchises of the old Fishkill and Matteawan (N. Y.) Gas Light Company were recently sold at auction by the Receiver, Mr. James M. DeGarmo. The purchaser was Mr. W. H. Fritchman, who represented the Investors' Securities Trust, of this city. The property brought $725 above the outstanding liens, which amounted to about $16,000. The present owners will put the plant in good working shape.

THE Berlin Iron Bridge Company, of East Berlin, Conn., has secured the contract for furnishing steel trusses for the new building which is to be erected by the proprietors of the Holyoke (Mass.) gas works. The building is to be 50 feet wide and 60 feet long. The roof trusses are to be entirely of steel, and the covering is to be of slate. No woodwork, or inflammable material of any sort, will be used in the construction.

MR. FISHER WELLES has been elected President of the Towanda (Pa.) Gas Company; vice Mr. Stanley W. Little, resigned.

AT the annual meeting of the shareholders of the Gas Light Company, of the City of New Brunswick, N. J., the Directors chosen were: Henry L. Janeway, J. Bayard Kirkpatrick, S. V. D. Clark, Lafferd Totten and Loyal J. Ives. The Directors elected the following executive management: President, J. B. Kirkpatrick; Treasurer, Lafferd Totten; Secretary, John W. Newell.

WE understand that the Trustees of the natural gas supply for Urbana (Ohio) have leased the entire system to the Inter-State Gas Company, of Toledo (Ohio), the lease to run for 20 years.

THE proprietors of the Washington (D.C.) Gas Light Company have notified the holders of the certificates of indebtedness in that Company that, according to an Act of Congress passed this year, the certificates will be converted into capital stock, at the par value of $20 per share, as soon after August 1st as convenient or possible. The amount of certificates outstanding is close to $600,000.

THE proprietors of the Lynn (Mass.) Gas and Electric Company decided to erect a handsome office building on the site on Exchange street, where the old office building (it was destroyed by the disastrous fire that occurred in Lynn in 1889) formerly stood. The dimensions of the building are, according to the plans, 63 feet by 62 feet, and 36 feet high. That height permits of three stories, each of ample elevation.

AT the annual meeting of the Exeter (N.H.) Gas Light Company, the following result was reached: Directors, William Burlingame, Nathaniel Pierce, Edward Hatch, A. P. Browne and Odiorne Swain; President, William Burlingame; Treasurer, A. P. Browne; Clerk, Arthur F. Cooper.

THE Davis & Farnum Mfg. Co., of Waltham, Mass., will construct a storage holder for the Newburyport (Mass.) Gas and Electric Company.

SUPT. WILLIAMS, of the Santa Barbara (Cal.) Gas Company, says that it is on the cards to order a reduction in the selling rate to $2.50 per 1,000 cubic feet on lighting account, the fuel rate to be $2 per 1,000.

AN item from Norristown, Pa., is to the effect that pursuant to action taken at a recent meeting of the stockholders of the Spring City Light Company, of Royersford, Pa., the Company made an assignment to Mr. William Rennyson, the Company's Secretary and Treasurer. The assignment was ordered by a vote of 2,250 out of the existing 2,500 shares, and it is ascribed to business complications and inability to realize on the assets.

THE following bids were submitted by the San Antonio (Texas) Gas and Electric Lighting Company, in response to an invitation from the authorities for tenders for the public lighting of that place: 200 arcs, 1 year contract, 60 cents per lamp per day; 3-year contract, 50 cents; 5-year contract, 45 cents; 250 arcs, 1-year, 60 cents; 3-year, 55 cents; 5-year, 50 cents; 300 arcs, 3-year, 55 cents; 5-year, 50 cents.

THE Salem (Mass.) Company has established a uniform rate to all its consumers, irrespective of the quantity of gas used per month.

IT is said that the Fall River (Mass.) Company will put down 7 miles of pipe this summer.

THE proprietors of the Pomona (Cal.) Gas and Electric Light Company have made arrangements to instal a water gas plant.

THE San Francisco (Cal.) *Chronicle*, of the 6th inst., had this to say about the agreement between the San Francisco Gas Light Company and the Edison Light and Power Company: "The committees of the San Francisco Gas Light Company and of the Edison Light and Power Company to whom the proposition to consolidate the two corporations was submitted, have at last reached a conclusion. While the approval of the Board of Directors is necessary to give effect to the arrangement of their acquiescence there is not the least doubt, the composition of the committees insures that. In addition, the proposition will be circulated among the shareholders of the Companies. Should it encounter serious opposition, the project would be dropped. This, however, is considered such a problematical contingency that the Gas Company has proceeded as if it did not exist, selling real estate and placing other land on the market for the purpose of closing up its affairs. By the arrangement reached the capital stock of the new concern will consist of 200,000 shares of the par value of $100 a share, equivalent to $20,000,000. Of these shares, 127,500 will be issued. One hundred thousand shares will be apportioned to the shareholders of the Gas Company, and 27,500 to those of the Electric Company. The proportion is nearly four to one in favor of the Gas Company, which, therefore, in effect, absorbs the Edison Light and Power Company controlling the new organization. Under the agreement each of the old Companies is to turn over to the new corporation its lands, plants and other properties, and to have its obligations assumed by the consolidated Company. From this arrangement the lands of the Gas Company on Howard and King streets are excepted. The reason for this is that its debts are nominal, and by the sale of these properties will not only be canceled, but a surplus will be left to be divided among its shareholders. This done, the San Francisco Gas Light Company will disincorporate. The situation of the Edison Light and Power Company is very different. With its guarantee of the California Electric Company's liabilities, it has a bonded indebtedness of about $800,000. While this remains unpaid it cannot disincorporate. The balance of the Consolidated Company's capital stock is to be held as a treasury reserve to be sold later, if desired, to raise money without bonding. The idea is to insure dividends at 6 per cent. on the issued capital stock, after the cost of operation and extension and the meeting of outstanding obligations have been satisfied. Under the consolidation the double payment of high salaries will be avoided, and in making extensions mains for only gas or electricity will be laid on the same block. It is thus believed that not only will a net return of 6 per cent. on the capital be obtained, but that it will be able to maintain this profit and at the same time reduce rates to the public, for both illumination and power. It will be 60 days yet before the consolidation can be put in effect, as it will be necessary for the representatives of each Company to examine the books and investigate the condition of the other, to ascertain if they are as stated."

THE projected construction of a gas works for Waterville, Maine, is again in evidence. We are told that Boston capalists now have the matter in hand.

MR. JOHN CURTISS, at one time Superintendent of the Le Roy (N.Y.) Gas Company, died at his home in Le Roy, on the morning of the 13th inst.

MR. FREDERICK TUCKERMAN has been appointed to the vacancy in the Board of Directors of the Amherst (Mass.) Gas Company, occasioned by the death of Mr. B. F. Kendrick. The Company also decided to remove the electric lighting plant to the site recently purchased with that object in view.

A CORRESPONDENT in Baltimore forwards the following, under date of the 15th inst.: "Major W. Stuart Symington, Superintendent of Lamps and Inspector and Sealer of Meters for Baltimore, to-day handed his resignation to Major Hooper, to take effect July 1st. He has accepted the position of Vice President of the Eckington and Soldiers' Home Railway Company, of Washington, D.C., and will leave Baltimore, where he has resided for many years, and make his home at the capital. Major Symington has held the office of Superintendent of Lamps and Inspector and Sealer of Gas Meters for over six years, having been appointed by Mayor Davidson in 1890. He was re-appointed thrice by Mayor Latrobe, and his last term really expired on March 1st, though he held over because of the differences between the Mayor and the Council. The Mayor said to-day he would appoint Major Symington's successor when the proper time arrived, though he had not selected him as yet. The salary of the office is $2,000 a year. When the 'green bag' was sent to the Council in February, it contained the nomination of Mr. A. N. Palmer, then, as now, Mayor's Clerk, for Superintendent of Lamps and Inspector and Sealer of Gas Meters. Although Mr. Palmer is a Democrat, it was at first expected that his nomination would be confirmed, because the Council had already approved his nomination as Mayor's Clerk. The 'combine,' however, changed its tune, and while not rejecting the nomination, elected Mr. Thomas W. Cromer to the place when the plums were voted away under the 'grab' ordinances."

THE repeated assertions in the daily press of Pawtucket, R. I., to the effect that the gas supplied by the Pawtucket Gas Company was deficient in purity and illuminating value, would seem to be in a fair way towards proof or disproof, through the following positive and common sense action of the proprietors of the Gas Company:

"To the Honorable, the City Council of Pawtucket—Gentlemen: At a meeting of the Directors of the Pawtucket Gas Company the following resolution was adopted and ordered to be presented to your honorable body:

"*Voted*, That in view of the frequent criticisms of the Pawtucket Gas Company, reflecting upon the quality of the gas, that the city authorities be invited to satisfy themselves and the public by appointing some competent and fair minded person, who may be a city official, to witness the daily test at the works of the candle power of this gas furnished to the city; and said official may furnish a certificate of the same, to be signed by him and the Company's Superintendent, or person making the test, which certificate shall be published in the newspapers at the pleasure of said city authorities, for the benefit and satisfaction of the consumers. Yours respectfully, WILLIAM MCGREGOR, Superintendent."

THE City Assessor of Topeka, Kas. (Mr. Edson), in a seemingly erratic moment, raised the valuation of the property of the Excelsior Coke and Gas Company, for purposes of taxation, from $27,500 to $80,000. The raise was made without any notification to the proprietors of the Company, whose real intention was to apply for a reduction from the $27,500 figure.

WRITE to the Mica Manufacturing Company, of 88 Fulton street, New York, for a copy of its new "Micasmith's Catalog." Mr. O'Neill, the proprietor of the Company, judging from the appearance of the specimen of the catalogue before us, is quite an adept in the clever preparation of illustrated price lists.

AT the annual meeting of the shareholders in the Reading (Pa.) Gas Company, the Managers chosen were: Horatio Trexler, Charles Breneiser, E. D. Smith, William A. Arnold, Isaac Hiester, William R. McIlvain and John I. Kutz.

MR. E. P. CALLENDER, Secretary and Superintendent of the Little Falls (N.Y.) Gas Light Company, writing under date of the 15th inst., says that the Company's receipts for gas sold in May, 1896, compared with the returns on like account for May, 1895, show an increase of 77 per cent. Since Feb. 1 the Company has gained 55 consumers and has placed 21 appliances for cooking by gas.

THE proprietors of The Gas and Electric Company, of the City of Mexico, are at odds with the authorities over the public lighting contract. The present contract, which was made on Aug. 8, 1888, for a term of eight years, contains a provision to the effect that the Company had the right to a renewal thereof for a further period of eight years, at the rates agreed upon in 1888. The authorities now insist that the rates are excessive, and that it would not be in accord with public policy to permit the renewal clause to become operative. "That," as our correspondent adds, "is the Mexican of it."

AT the annual meeting of the shareholders of the Port Hope (Ont.) Gas Company, the President (Mr. John Smart) submitted the following summary of the standing of the Company: "Our gas sales for the year show an increase of about 5 per cent. The outlay caused by the extension of our mains and services, to meet the demands for gas for cooking, has caused quite a large increase in our expenditures, and has absorbed about $600 of our earnings. The corporation has also increased our taxes by $128. The reduction in the price of gas for cooking purposes, and the outlay for extensions, will, we trust in the future, prove profitable to the Company. Out of our earnings for last year a dividend at the rate of 3 per cent. has been declared upon our capital stock." President Smart further said: "Our output of gas for lighting is about the same as last year, but for cooking it shows quite an increase. The cost, however, of extensions and new services to meet the demand has largely exceeded the present benefit received by the Company. This, with the reduction in price to consumers, has caused the declaration of a smaller dividend, but it is hoped that the cheapening of gas for fuel purposes will lead to a largely increased consumption in the near future." He also referred to the popularity of the Welsbach lamps, giving the following instance as proof that they were effective weapons in dislodging incandescent electric lamps: "Two of those lamps (consuming 3 feet per hour each) have replaced 6 electric 16-candle power lamps in one of our stores." The reports having been accepted, the ballot for Directors was in favor of the old Board; and the latter subsequently organized by re-electing Mr. Smart as President and Managing Director.

THE St. Augustine (Fla.) Gas and Electric Light Company has wisely determined to move into office quarters, better adapted to its purposes than those now occupied by it, in that the new location is right in the business centre of the city. The rooms selected are in the Lyon building, fronting St. George street.

IT is not at all improbable that the authorities of Paterson, N.J., will go into Welsbach lighting on public account, on quite a large scale.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

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MONDAY, JUNE 22, 1896.

Lighting Jute Mills in India.

An exchange says that the electric light has afforded a very satisfactory solution of a difficulty that presented itself in the Bengal jute mills. An increased product was required, but many of the mills were already worked to their full capacity. The habits of the natives, consequent upon the great heat during nine months of the year, their weaker constitutions, the distance in some cases of their dwellings, and their love of bathing, led them to prefer laboring in what may be described as alternating shifts, so that they might work at two different parts of the day with a pretty long interval between. Until recently the engines started at daybreak in the morning and ran till sunset—about 5:30 in winter and 7 in summer. Artificial lighting by either oil or gas would have been considered objectionable on account alike of the risks of fire, the fumes and the heat.

It occurred to the proprietor of one mill that by running night and day, with the electric light, they could nearly double the production from the same machinery. The electric light was put in, and the plan worked so well many other mills have followed suit, establishing a minimum daily schedule of 14 hours. The coolie is cleanly, both by inclination and religious observance, and he loves to bathe daily. He will spend many hours in the cultivation of the little patch of garden around his house. Then comes the bath, which is followed by the anointing and rubbing of the whole of the body with oil, to preserve the suppleness of the limbs, and afterwards the modest pipe of opium, and the leisurely rest on the grass-woven couch. These are luxuries which the East Indian will make almost any sacrifice to enjoy, so it is not surprising that the new night shift at the jute mills is already a highly popular institution.

The Market for Gas Securities.

Investors paid their respects to Consolidated Gas in no wavering way this week, the stock moving up, on fairly large transactions, to 161½. The maximum was recorded on Wednesday, but profit-taking subsequently caused a slight reaction, the opening to-day (Friday) coming in at 159 to 160. The stock is cheap. New York and East River common is steady, at 37 to 38½, as also is Standard common, some inquiry for which was made during the week at 78½ to 80½. Equitable is a trifle easier, and Mutual shows no change. Brooklyn Union, which is now regularly called on the Exchange, moved up sharply to 95, and there is every likelihood that it will go to par before long. Chicago gas is unaccountably weak. In our opinion, on its intrinsic value, it would be cheap at 75. Baltimore Consolidated is in demand at 63 to 63½, and Bay State is dull and lower at 25 to 26½. Consumers, of Jersey City, is listless, at 78 to 80. The Indiana group are firm, notably Lafayette, the stock of which is about equal in value now to the value of the bonds. A feature of the market has been the advance in Detroit gas, which is quoted at 32 bid.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

JUNE 22.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	159	160
Central	500,000	50	150	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	200	203
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	225	235
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	37	38¼
Preferred	2,000,000	100	70	75
Bonds 1st 5's	3,500,000	1,000	103	104
" 1st Con. 5's	1,500,000	..	92	93½
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	78¾	80½
Preferred	5,000,000	100	107	108¼
Bonds, 1st Mortgage, 5's	1,500,000	1,000	109½	111½
Yonkers	299,650	50	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	94¼	95
" " Bonds (5's)	15,000,000	1,000	106¾	..
Bay State	5,000,000	50	22	23½
" Income Bonds	2,000,000	1,000	..	42
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	84	85
2d " " "	3,000,000	1,000	66	70
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	68½	69¼
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,000,000	..	..	65
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	..	80
" Bonds	600,000	1,000	99	101
Cincinnati G. & C. Co.	7,000,000	100	198¾	200
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	41
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	63	63½
Mortgage, 6's	3,000,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	32	33
" Con. Bonds	4,312,000	..	..	82
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	87	90
" Bonds	2,000,000	..	93	95
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	132	136
" Bonds, 6's	2,650,000	..	104	105
Jersey City	750,000	20	180	.
Lafayette Gas Co., Ind.	1,000,000	100	98	9
Bonds	1,000,000	1,000	94	97
Louisville	2,870,000	50	..	180
Laclede, St. Louis	7,500,000	100	98	29¼
Preferred	2,500,000	100	..	83
Bonds	9,084,400	1,000	93	93¼
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	98	98
Bonds, 6's	4,000,000	..	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	82	83½
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	94¼	95
St. Paul Gas Light Co.	1,500,000	100	67½	70
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	68	69
Bonds, 5's	3,556,000	.	89	90½
Wilmington, Del.	500,000	5	188	190

Advertisers' Index.

GAS ENGINEERS.

	Page
Jos. R. Thomas, New York City	1034
Wm. Henry White, New York City	1031
Fred. Bredel, Milwaukee, Wis.	1014
H. C. Slaney, Brooklyn, N. Y.	1031
Geo. R. Rowland, New York City	1031
The Western Gas Construction Co., Fort Wayne, Ind.	1022
Humphreys & Glasgow, New York City	1018
T. G. Lansden, St. Louis, Mo.	1031
American Gas Co., Phila., Pa.	1014
David Leavitt Hough, New York City	1033

CHEMISTS.

Herman Poole, New York City	1013

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md.	1029
United Gas Improvement Co., Phila., Pa.	1021
Burdett Loomis, Hartford, Conn.	1030
National Gas and Water Co., Chicago, Ills.	1023
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	1029
The Western Gas Construction Co., Fort Wayne, Ind.	1022

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City	1032
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Kerr Murray Mfg. Co., Fort Wayne, Ind.	1022
Stacey Mfg. Co., Cincinnati, Ohio.	1031
Bartlett, Hayward & Co., Baltimore, Md.	1029
Davis and Farnum Mfg. Co., Waltham, Mass.	1028
R. D. Wood & Co., Phila., Pa.	1030
Isbell-Porter Company, New York City	1030
Fred. Bredel, Milwaukee, Wis.	1014
United Gas Improvement Co., Phila., Pa.	1021
Berlin Iron Bridge Co., East Berlin, Conn.	1018
National Gas and Water Co., Chicago, Ills.	1023
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	1029
The Western Gas Construction Co., Fort Wayne, Ind.	1022
Humphreys & Glasgow, New York City	1018
Gas Engineering Co., Pittsburgh, Pa.	1028
American Gas Co., Phila., Pa.	1014

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R. D. Wood & Co., Phila., Pa.	1030
James R. Floyd & Sons, New York City	1032
Continental Iron Works, Brooklyn, N. Y.	1030
Gas Engineering Co., Pittsburgh, Pa.	1028

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md.	1029
Fred. Bredel, Milwaukee, Wis.	1014
J. H. Gautier & Co., Jersey City, N. J.	1026
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.	1026
Adam Weber, New York City	1026

TAR AND CARBONIC ACID EXTRACTOR.
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AMMONIA CONCENTRATORS.
Michigan Ammonia Works, Detroit, Mich.....1012
G. Shepard Page's Sons, New York City 1081
Gas Engineering Co., Pittsburgh, Pa.....1028

GAS METERS.
John J. Griffin & Co., Phila., Pa..... 996
American Meter Co., New York and Philadelphia.....1035
The Goodwin Meter Co., Phila., Pa.....1034
Helme & McIlhenny, Phila., Pa. 1035
D. McDonald & Co., Albany, N.Y.....1035
Nathaniel Tufts, Boston, Mass.....1034
Maryland Meter and Mfg. Co. Baltimore, Md.... 1034
Metric Metal Co., Erie, Pa 1034
Keystone Meter Co., Royersford, Pa.....1016
Buhl Stamping Company, Detroit, Mich.....1035

PREPAYMENT METERS.
American Meter Co.. New York and Philadelphia 1035
John J. Griffin & Co., Phila., Pa 996
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Ohio Pipe Co., Columbus, Ohio.....1033
M. J. Drummond, New York City..... 1033
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Warren Foundry and Machine Co., New York City.....1033
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Addyston Pipe and Steel Co., Cincinnati, O..... 1033

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Wm. Anderson, East Boston, Mass 1013

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Penn Gas Coal Co., Phila., Pa.....1025
Perkins & Co., New York City.....1024
Despard Gas Coal Co., Baltimore, Md.....1025
Westmoreland Coal Co., Phila., Pa..... 1025
Berwind-White Coal Mining Co., New York and Phila...1024

CANNEL COALS.
Perkins & Co., New York City.....1024
Macfarlane & Co., Louisville, Ky..... 1012

GAS ENRICHERS.
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C. M. Keller, Columbus, Ind..... 1025

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Connelly Iron Sponge and Governor Co., New York City 1023
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The Wilder Mfg. Co. Phila., Pa.....1013

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Isbell-Porter Company, New York City.....1030
Continental Iron Works, Brooklyn, N. Y.....1030
G. Shepard Page's Sons, New York City.....1031

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J. H. Gautier & Co., Jersey City, N. J.....1026
B. Kreischer & Sons, New York City..... 1026
Adam Weber, New York City 1026
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 1026
Cyrus Borgner, Phila., Pa 1026
James Gardner, Jr., Pittsburgh, Pa..... 1026
Henry Maurer & Son, New York City..... 1026
Baltimore Retort and Firebrick Co., Baltimore, Md..... 1026
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.....1026
Brooklyn Firebrick Works, Brooklyn, N. Y..... 1026

CEMENTS.
C. L. Gerould & Co., Mount Vernon, N. Y..... 1026

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Welsbach Commercial Co., Phila., Pa.....1015

MICA GOODS.
The Mica Mfg. Co., New York City.....1012

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C. A. Gefroner, Phila., Pa.....1030

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D. M. Steward Mfg. Co., Chattanooga, Tenn.....1013

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Wm. M. Crane & Co., New York City..... 1016

PURIFYING MATERIALS.
Connelly Iron Sponge and Governor Co., New York City 1023
Greenpoint Chemical Works, Brooklyn, N. Y.....1025
Henry W. Douglas, Ann Arbor, Mich.....1013

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The P. H. & F. M. Roots Co., Connersville, Ind.....1030
Isbell-Porter Company, New York City..... 1030
Connelly Iron Sponge and Governor Co., New York City 1023

VALVES.
Ludlow Valve Manufacturing Co., Troy, N.Y.....1022
Chapman Valve Manufacturing Co., Boston, Mass.....1052
R. D. Wood & Co., Phila., Pa.....1030
Continental Iron Works, Brooklyn, N. Y..... 1030
The P. H. & F. M. Roots Co., Connersville, Ind.....1030
Isbell-Porter Co., New York City.....1030
The Western Gas Construction Co., Fort Wayne, Ind....1022

ELECTRICAL APPARATUS.
Wm. Henry White, New York City.....1031

GAS ENGINES.
Otto Gas Engine Works, Phila., Pa..... 1026
The American Gas Engine Co., Phila., Pa..... 1027
Backus Water Motor Co., Newark, N. J.....1012

ENGINES AND BOILERS.
The Hazelton Boiler Company, New York City.....1013
W. G. & G. Greenfield, East Newark, N. J.....1013

PURIFIER SCREENS.
John Cabot, New York City 1013

GAS STOVES.
American Meter Co., New York and Philadelphia..... 1019
The Goodwin Meter Co., Phila., Pa.....1034
George M. Clark & Co., Chicago, Ills.....1017
Maryland Meter and Manufacturing Co., Baltimore, Md. 1034
William M. Crane & Co., New York City.....1016
Keystone Meter Co., Royersford, Pa.....1016
A. Weiskittel & Son, Baltimore, Md..... 1017

CHINA GAS KILNS.
William M. Crane & Co., New York City..... ... 1016

GASHOLDER PAINT.
New York Marine Paint Co., Poughkeepsie, N.Y.....1022

GASHOLDER TANKS.
J. P. Whittier, Brooklyn, N. Y..... 1022

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Bartlett, Hayward & Co., Baltimore, Md.....1029
Continental Iron Works, Brooklyn, N. Y.....1030
Delly & Fowler, Philadelphia, Pa.....1032
Davis & Farnum Mfg. Co., Waltham, Mass..... 1028
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 1028
Stacey Mfg. Co., Cincinnati, Ohio. 1031
R. D. Wood & Co., Philadelphia, Pa..... 1030

DIVIDEND NOTICE.

OFFICE OF WELSBACH LIGHT CO.,
DREXEL BUILDING, PHILA., June 10, 1896.

The Directors have this day declared a dividend of twenty (20) per cent., payable on June 26, 1896, to stockholders of record at the close of business June 19. Checks will be mailed.

N. B.—The transfer books close from June 20 to July 10, both inclusive, for the annual meeting.

1097-2 EDWARD C. LEE, Treasurer.

OFFICE OF THE LIGHTHOUSE BOARD, WASHINGTON, D. C., June 15, 1896. Proposals will be received at this office until 12 o'clock, M., of Tuesday, the 7th day of July, 1896, for furnishing and delivering illuminating gas for the Mobile Ship Channel Lights. The right is reserved to reject any or all bids, and to waive any defects. Specifications, forms of proposals, and other information may be obtained on application to this office.

THE LIGHTHOUSE BOARD, Washington, D. C.

WANTED.

By a young man of 20 years' experience, a position to take full charge of gas works, or Superintendent of manufacturing and distribution. Coal gas works preferred, especially where regenerative benches are in use or can be introduced. All-round man in all branches of the business. Have sold 30 gas ranges so far this season; 500 Welsbach lights now in use in town of 15,000 population. Competent and reliable references as to ability and character. Salary reasonable. Best of reasons for desiring a change. Address

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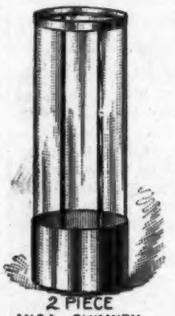

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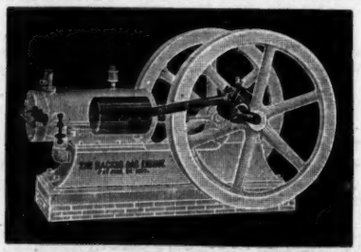

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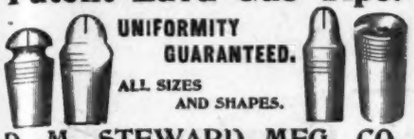

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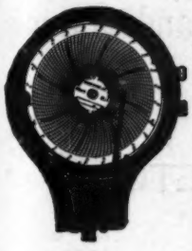

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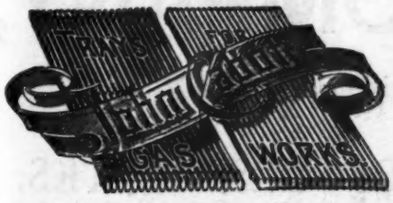

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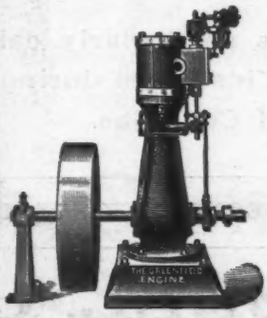

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All infringements of this Company's patents will be promptly and vigorously prosecuted, dealers and users being equally liable. This Company will prosecute all parties in whose possession infringing lights are found.

This notice is given in view of an effort now being made to introduce into this country infringing lights made in Germany, the sale of which, there, has been prohibited by the recent decision of the German Patent Office sustaining the validity of the Welsbach patents.

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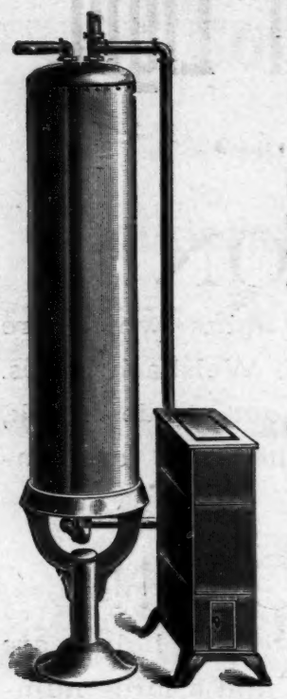

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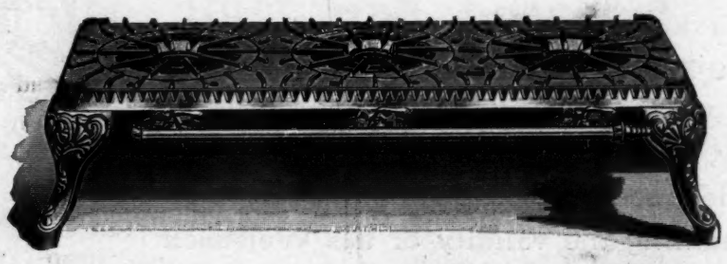

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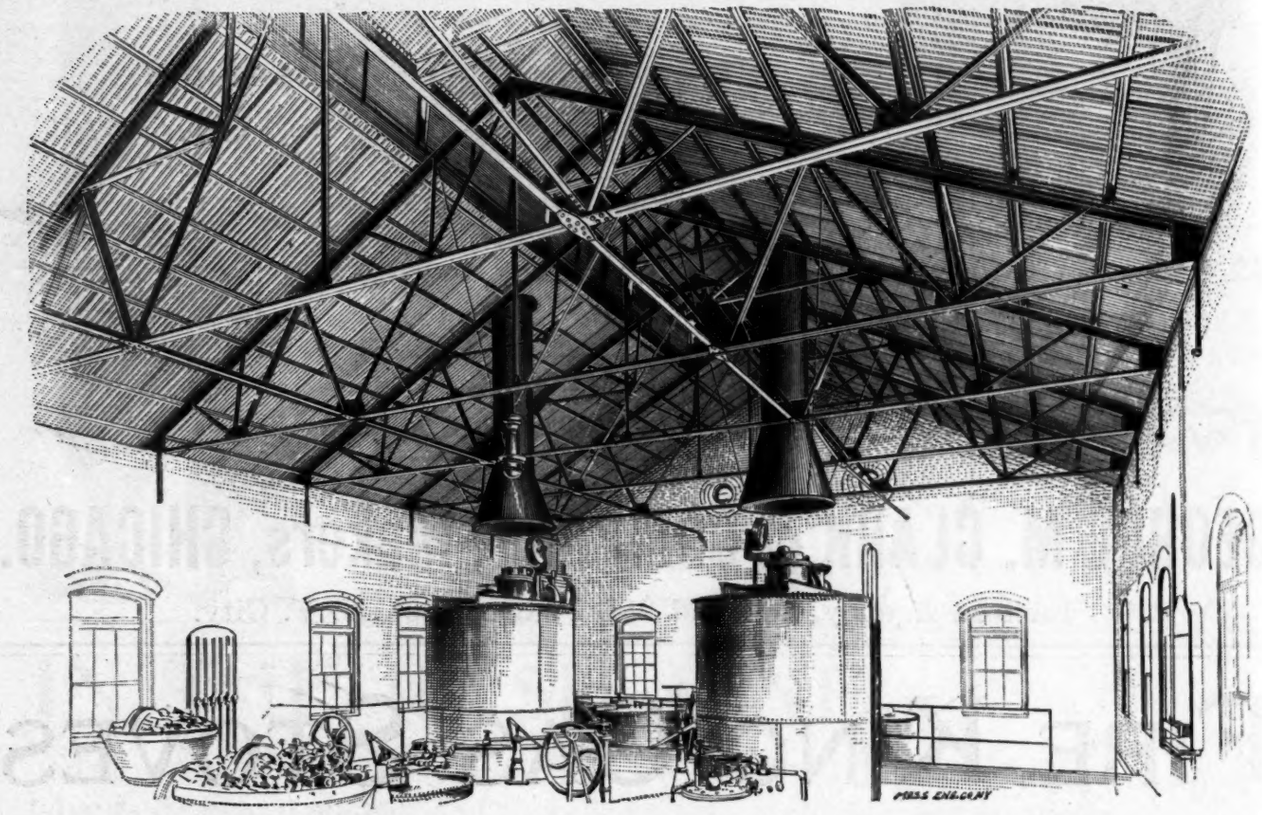

The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for the Providence Gas Light Company at Providence, R. I. The building is 40 ft. in width by 100 ft. in length, the side walls being of brick and the roof being entirely of iron—that is, iron trusses and iron purlins covered with corrugated iron. The building is ventilated by our Improved Ventilators, extending the full length of the roof, with side shutters opened and closed by cords from the floor. No woodwork is used in any way about the construction of the building.

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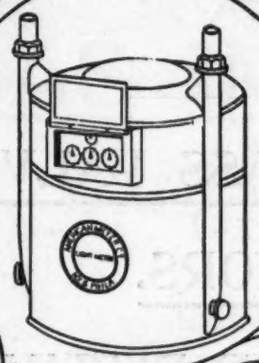
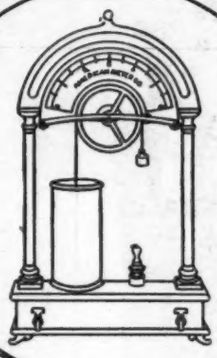
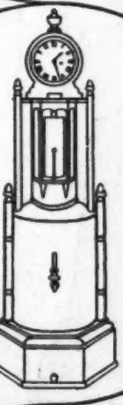
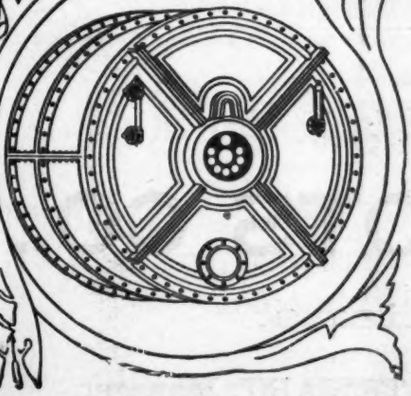




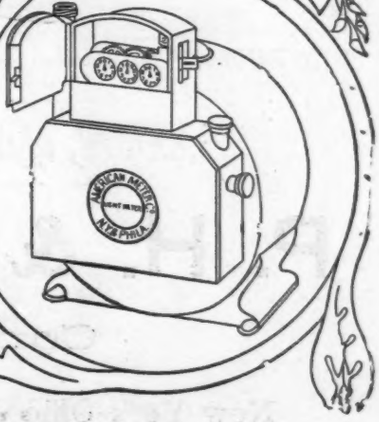




PUBLIC LIGHTING TABLE.

JULY, 1896.

Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguish.
				P.M.	A.M.
Wed.	1	8.00 PM	12.00 AM	7.30	3.15
Thu.	2	8.00 LQ	12.30	7.30	3.15
Fri.	3	8 00	12.50	7.30	3.15
Sat.	4	8.00	1.10	7.30	3.15
Sun.	5	8.00	1.40	7.30	3.15
Mon.	6	8.00	2 20	7.30	3.15
Tue.	7	8.00	3.40	7.30	3.15
Wed.	8	8.00	3.40	7.30	3.15
Thu.	9	8.00	3.40	7.30	3.15
Fri.	10	8.00 NM	3.40	7.30	3.15
Sat.	11	8.00	3.40	7.30	3.15
Sun.	12	8.00	3.40	7.30	3.15
Mon.	13	8.00	3.40	7.30	3.15
Tue.	14	8.00	3.40	7.30	3.15
Wed.	15	9.10	3.40	7.30	3.15
Thu.	16	9.40	3.40	7.20	3.15
Fri.	17	10.10 FQ	3.40	7.20	3.15
Sat.	18	10.40	3.40	7.20	3.15
Sun.	19	11.20	3.50	7.20	3.15
Mon.	20	12.10 AM	3.50	7.20	3.15
Tue.	21	1.10	3.50	7.20	3.15
Wed.	22	2.20	3.50	7.20	3.15
Thu.	23	No L.	No L.	7.20	3.15
Fri.	24	No L.FM	No L.	7.20	3.15
Sat.	25	No L.	No L.	7.20	3.15
Sun.	26	7.50 PM	9.30 PM	7.20	3.15
Mon.	27	7.50	9.50	7.20	3.15
Tue.	28	7.50	10.10	7.20	3.15
Wed.	29	7.50	10.30	7.20	3.15
Thu.	30	7.50	10.50	7.10	3.30
Fri.	31	7.50	11.10	7.10	3.30



TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs.Min	By Table No. 2.	Hrs.Min.
January	220.40	January	423.20
February	207.00	February	367 40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142 10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00

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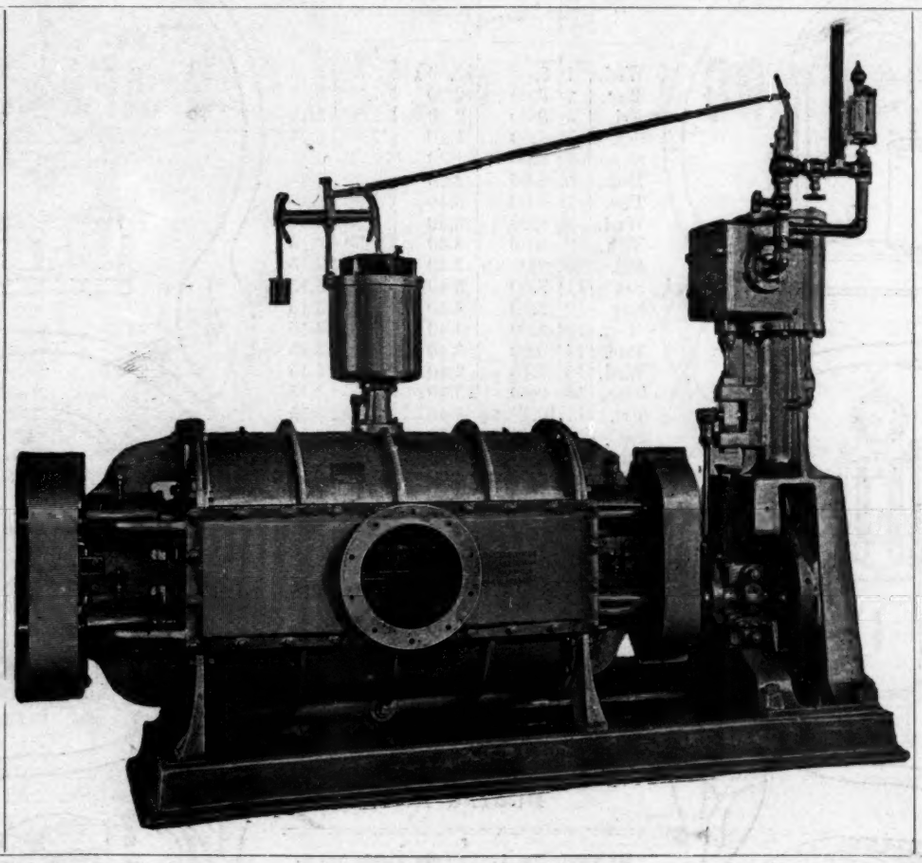

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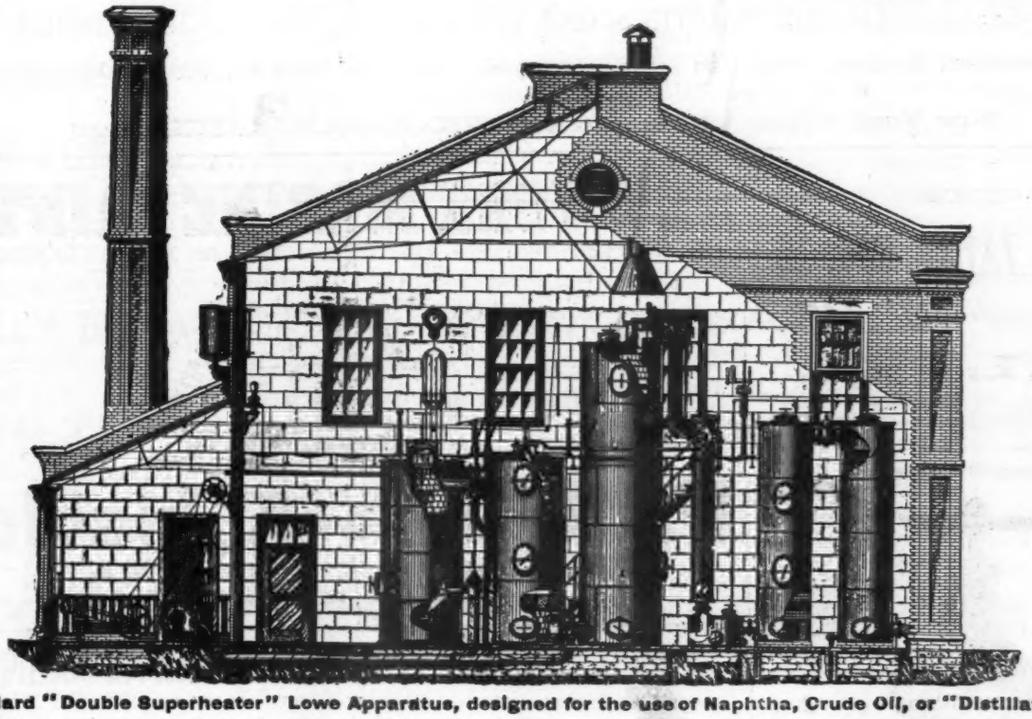

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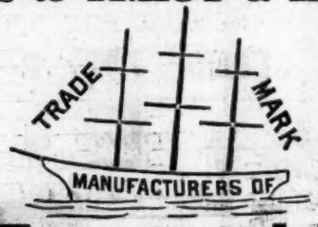

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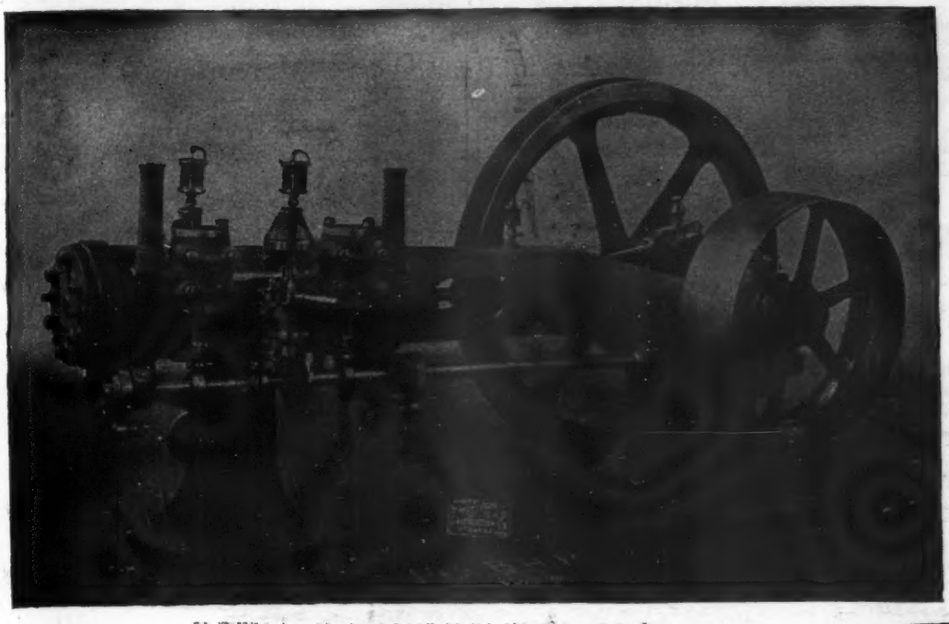

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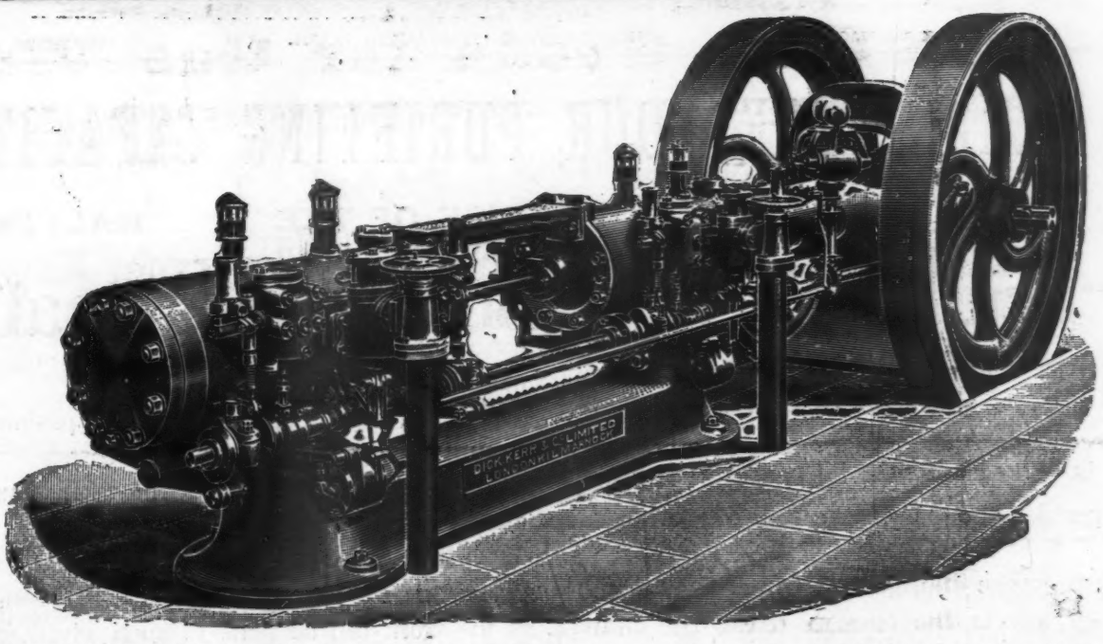

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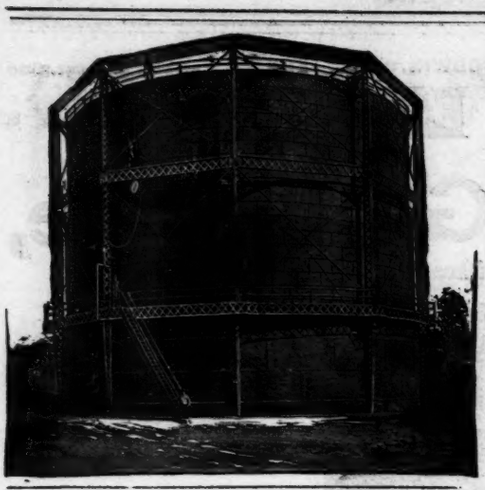

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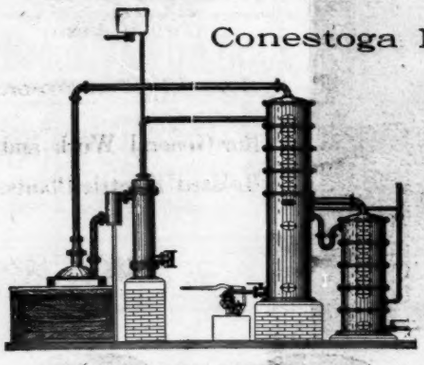

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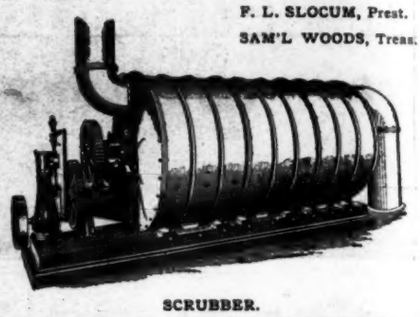

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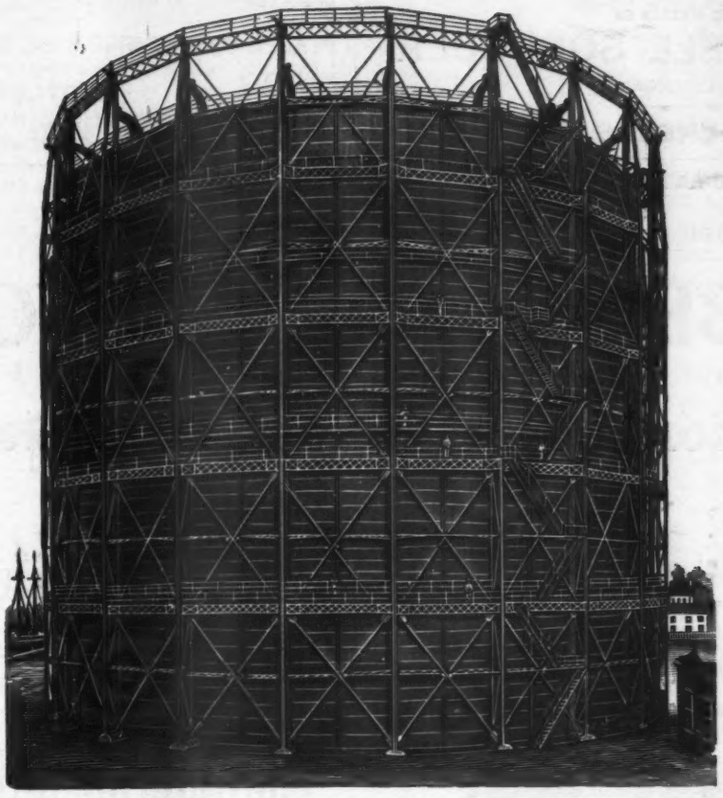

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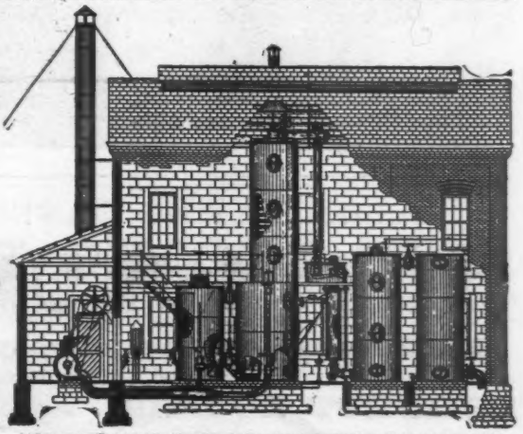

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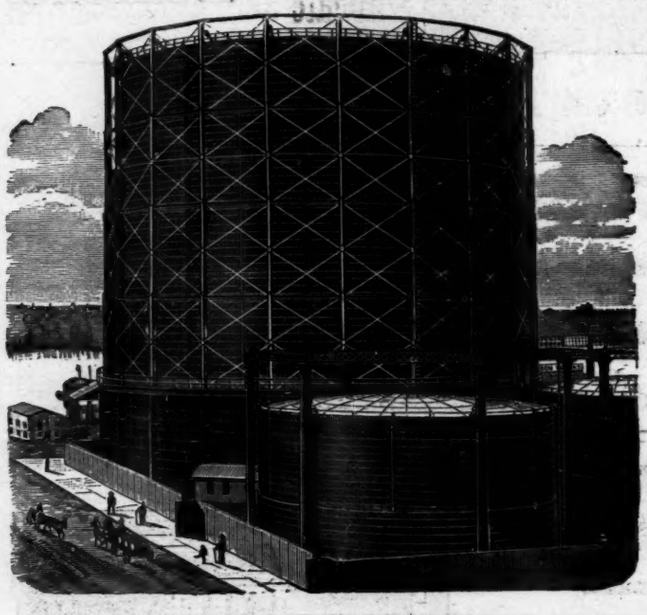

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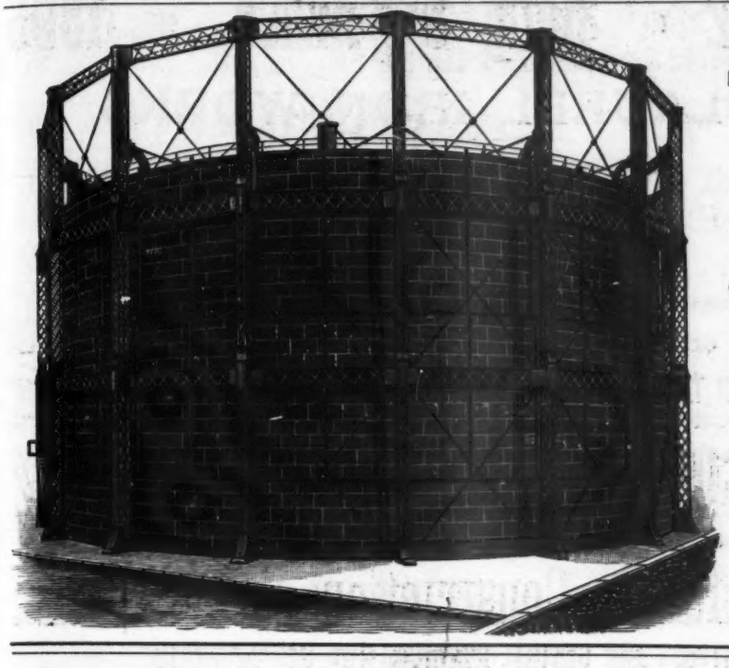

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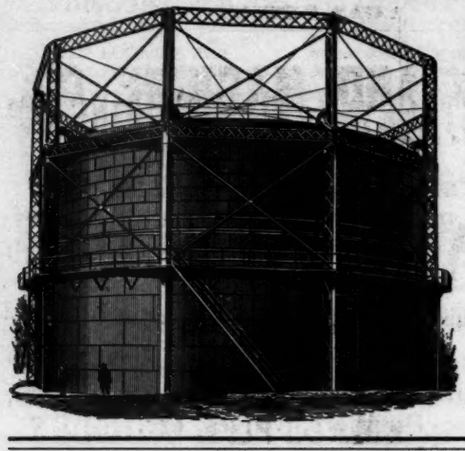

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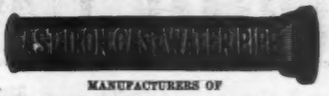

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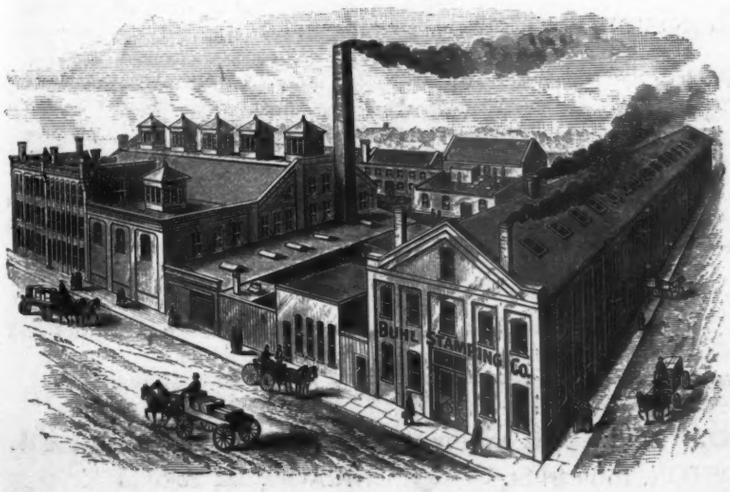

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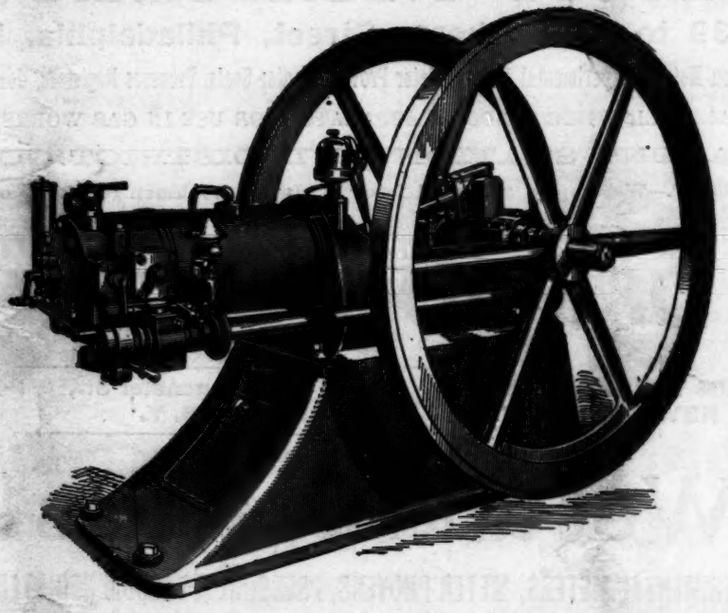

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